


2012

## The Foods And Crops Of The Muisca: A Dietary Reconstruction Of The Intermediate Chiefdoms Of Bogota (bacata) And Tunja (hunza), Colombia

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THE FOODS AND CROPS OF THE MUISCA: A DIETARY RECONSTRUCTION OF THE  
INTERMEDIATE CHIEFDOMS OF BOGOTÁ (BACATÁ) AND TUNJA (HUNZA),  
COLOMBIA

by

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B.A. University of Central Florida, 2005

A thesis submitted in partial fulfillment of the requirements  
for the degree of Master of Arts  
in the Department of Anthropology  
in the College of Sciences  
at the University of Central Florida  
Orlando, Florida

Spring Term  
2012

Major Professor: Arlen F. Chase

## **ABSTRACT**

The Muisca people of the Eastern Cordillera of Colombia had an exceptionally complex diet, which is the result of specific subsistence strategies, environmental advantages, and social restrictions. The distinct varieties of microclimates, caused by the sharp elevations in this part of the Andes, allows for a great biodiversity of plants and animals that was accessible to the native population. The crops of domesticated and adopted plants of the Muisca include a wide variety of tubers, cereals, fruits, and leaves that are described in detail in this thesis. The Muisca used an agricultural method known as microverticality where the different thermic floors are utilized to grow an impressive variety of species at various elevations and climates. This group also domesticated the guinea pig, controlled deer populations and possibly practiced pisciculture, patterns that are also described in this text. Some of the foods of the Muisca were restricted to specific social groups, such as the consumption of deer and maize by the chiefly classes and the consumption of roots and tubers by the lower class, hence the complexity of their dietary practices.

The utensils utilized in the preparation and processing of foods, including ceramics and stone tools were once of extreme importance in the evolution of the Muisca diet and form an important part of this research as well as the culinary methods that are described in the Spanish chronicles and by contemporary experts. The majority of food products utilized by the Muisca in antiquity are still part of the diet of contemporary Colombians and the current uses of these foods can allow us to understand how these products were used by this pre-Columbian society. On the other hand, knowledge of the practices used by the Muisca can facilitate the preservation of these foods in the modern diet and avoid the introduction and replacement of these foods by non-native products, which can be less nutritious.

## ACKNOWLEDGMENTS

This manuscript is dedicated to the memory of Dr. Elayne Zorn, especially for her guidance and contribution of ideas that I implemented during this investigation. This thesis could have never been finished without her unconditional support. I would like to thank my thesis committee Dr. Arlen Chase, Dr. Diane Chase, and Dr. John Walker for their support, advice, and especially for their patience; to my mother for using a great variety of foods in her cooking found in our country, many of them described in this work; Jennifer Navarra, my wife and plant ecologist, who aided me in the taxonomic identification and description of plants mentioned in this text; Lisa Lomitola for her wonderful inking of the majority of the artifact drawings shown here and to all my colleagues who reviewed this work.

I am grateful to the staff at the Museo del Oro in Bogotá, especially to Luz Elena Gomez for facilitating the permits to access the ceramic and stone tools deposit at the museum and to Angela Ovalle. I want to thank the staff at the section of *Libros Raros y Manuscritos* at the Luis Ángel Arango library in Bogotá for allowing me access to this collection; to the Department of Anthropology at the Universidad Pedagógica y Tecnológica de Colombia in Tunja for granting me access to their collection of faunal and plant remains, especially to Helena Pradilla for granting me permission to use materials from her research in this thesis and for allowing me to export osteological material for a possible future project. I also thank all the merchants and farmers who gave me information about food products. Special thanks go to: Milly Tocancipa for letting me use her house as a laboratory to examine, cook, measure and store food products; to Gloria Patrón for giving me an insider's experience of the produce markets and introducing me to farmers and merchants there; and to Angel Cardec, director of the Office of International Studies at UCF, for his support.



## TABLE OF CONTENTS

LIST OF FIGURES .....	viii
LIST OF TABLES .....	xv
CHAPTER ONE: INTRODUCTION .....	1
Overall Aims and General Questions .....	9
CHAPTER TWO: REVIEW OF THE LITERATURE .....	11
Archaeology .....	11
Ethnohistory .....	16
Ethnography and Ethnobotany .....	18
CHAPTER THREE: THE MUISCA .....	21
Geography and the Environment .....	21
Periods of Human Occupation in Cundinamarca and Boyaca .....	22
Preceramic Period .....	23
The Herrera Period .....	24
The Early Muisca Period .....	27
The Late Muisca Period .....	29
Political Structure and Social Organization .....	32
CHAPTER FOUR: MATERIALS, METHODS AND ANALYSIS STRATEGY .....	35
Archaeology .....	35
Ethnohistory .....	38
Ethnobotany .....	39
CHAPTER FIVE: FINDINGS .....	42
Plants .....	43

Tubers and Roots .....	44
<i>Canna edulis</i> : Achira or Canna.....	44
<i>Arracacia xanthorrhiza</i> : Arracacha .....	49
<i>Tropaeolum tuberosum</i> : Cubios or Navos .....	52
<i>Oxalis tuberosa</i> : Ibias.....	55
<i>Ullucus tuberosum</i> : Chuguas, Rubas or Ulluco .....	56
<i>Polymnia edulis</i> : Jicama .....	59
<i>Solanum tuberosum</i> , <i>Solanum colombianum</i> or phureja, <i>Solanum andigena</i> , <i>Solanum</i> <i>rybinii</i> and <i>Solanum boyasence</i> : Potatoes.....	59
<i>Manihot esculenta</i> : Yuca.....	62
<i>Ipomoea batatas</i> : Sweet Potatoes .....	63
Methods for the Preparation of Roots and Tubers .....	65
Grains/Cereals.....	66
<i>Zea Mays</i> : Corn.....	66
Methods for the Preparation of Corn .....	72
<i>Chenopodium quinoa</i> : Quinoa .....	73
Legumes .....	76
<i>Phaseolus vulgaris</i> : Frijól, Common Bean.....	76
<i>Arachis hypogaea</i> : Peanut.....	80
<i>Erythrina edulis</i> : Chachafruto or Balú .....	80
<i>Inga feuillei</i> : Guama .....	82
Fruits .....	83
Shrub and Vine Fruits .....	84

<i>Curcubita maxima</i> and <i>pepo</i> : Ahuyama and Calabaza .....	84
<i>Capsicum</i> sp.: Ají or Pimiento .....	87
<i>Annanas comosus</i> : Pineapple .....	90
<i>Physalis peruviana</i> : Uchuva .....	91
<i>Solanum quitoense</i> : Lulo .....	93
<i>Passifloras</i> : Passion fruits .....	94
Fruit Trees .....	100
<i>Persea Americana</i> : Aguacate .....	100
<i>Psidium guajava</i> : Guava .....	103
<i>Cyphomandra betacea</i> : Tomate de Arbol .....	105
<i>Annona cherimola</i> , <i>muricata</i> and <i>squamosal</i> : Chirimolla, Guanábana and Anón .....	106
<i>Carica</i> : Papayas .....	109
Berries .....	110
<i>Vaccinium meridionale</i> : Agrad .....	110
<i>Rubus glaucus</i> , <i>Rubus macrocarpus</i> , <i>Rubus adenotrichus</i> : Mora de Castilla, Zarzamora or Morón and Mora Común or Silvestre .....	112
Leafs .....	115
<i>Galinsoga pawiflora</i> : Guasca: .....	115
<i>Erythroxylum coca</i> : Coca .....	116
Fauna .....	120
Mammals .....	122
<i>Cavia porcellus</i> : Guinea pig .....	122
<i>Odocoileus virginianus</i> , <i>Mazama rufina</i> , <i>M. Americana</i> , <i>M. goazoubira</i> : Deer .....	127

Other Mammals: .....	130
Birds .....	131
Fish.....	133
Muisca Artifacts Used for Processing, Service, Preparation, and Storage of Food Products.	137
Ceramics .....	137
Stone tools and Bone Tools .....	142
CHAPTER SIX: LIMITATIONS OF RESEARCH.....	145
CHAPTER SEVEN: CONCLUSION AND IMPLICATIONS.....	147
APPENDIX A: COPYRIGHT PERMISSION LETTER FOR FIGURE 1 .....	151
APPENDIX B. GENERAL AND BOTANICAL DESCRIPTIONS .....	153
APPENDIX C: TABLES .....	166
APPENDIX D: ARTIFACT SCALE DRAWINGS .....	183
LIST OF REFERENCES .....	191

## LIST OF FIGURES

Figure 1: Chiefdoms of the Northern Andes. Darker purple area shows the Muisca territory at the time of the Conquest (map courtesy of the Instituto Geográfico Agustín Codazzi Bogotá, Colombia Appendix A).....	3
Figure 2: Map showing the domain of the Muisca before the conquest. Segmented lines show the limits of each of the five Muisca chiefdoms. Map created by the author from information in Rojas (1977).....	8
Figure 3: General map of the archaeological sites of Los Altos Santuarios and La Muela UPTC. (Based on information by Pradilla <i>et al.</i> 2005).....	12
Figure 4: Modern ceramics from La Chamba, Tolima (left). Artisan at his workshop at La Chamba, Tolima near a clay oven (right). ....	26
Figure 5: <i>Mucuras</i> , Muisca mummy, gold offerings: <i>Tunjos</i> , cacique regalia (top: left to right). Jar with high neck, olla <i>cuarzo abundante</i> , jars with globular bodies (bottom left to right) Museo del Oro Bogotá, Colombia. ....	28
Figure 6: Phallic monument at the site El Infiernito, Colombia. Gold regalia. Golden cacique figurine wearing regalia (top left to right). Gold chest plate. Gold offering representing high status individuals. Muisca raft possibly used in El Dorado ritual (bottom left to right). Museo del Oro Bogotá, Colombia. ....	31
Figure 7: Archaeology Laboratory at the UPTC, Tunja: Muisca craniums from La Muela, Ceramics from La Muela, Deer bone samples from La Muela (top left to right). Deer bone remains from La Muela, Guinea pig pelvises from La Muela, Archaeological site of La Muela, Tunja currently the UPTC (bottom left to right).....	37

Figure 8: Ceramic and stone tools deposit at the Museo del Oro, Bogotá, Muisca stone tools, metate (top left to right); Muisca axe, atlatl, Muisca ceramics (bottom left to right).....	38
Figure 9: Paloquemao market, Bogotá (left). Codabas market, Bogotá (right). .....	41
Figure 10: Neiva market, Huila (left). Villa de Leyva market, Boyaca (right). .....	41
Figure 11: Plant ecologist Jennifer Navarra analyzing food products (left). Tunja market, Boyaca (right). .....	41
Figure 12: Variety of Muisca Crops. ....	42
Figure 13: <i>Achira</i> Rhizomes. ....	45
Figure 14: Merchant in the produce market in Neiva, Huila selling <i>achira</i> starch and achiote (top left). Selling <i>bizcochos de achira</i> in front of the house in Fortalecillas, Huila (top middle, top right). Making <i>achiras</i> in the patio Altamira, Huila (bottom left). Oven to bake <i>achiras</i> Altamira, Huila (bottom middle). <i>Achiras</i> del Huila package (bottom right).....	48
Figure 15: Large yellow <i>arracacha</i> variety (top). Pygmy <i>arracacha</i> variety. <i>Ajiaco</i> traditional soup of Cundinamarca with <i>arracacha</i> , two potato varieties, corn, avocado, <i>guascas</i> , cilantro, and chicken (bottom left to right). ....	51
Figure 16: Yellow Villa de Leyva, Colombia and white <i>Cubios</i> Bogotá, Colombia. White <i>Cubios</i> . <i>Cocido Boyasence</i> with <i>cubios</i> , <i>ibias</i> , <i>chuguas</i> , corn, chicken, potato, pork, and sausage traditional dish of Boyaca (left to right). ....	54
Figure 17: <i>Ibias</i> of the pink variety from Cundinamarca Bogotá, Colombia. ....	56
Figure 18: <i>Chuguas</i> brown variety purchased in Bogotá, Colombia. ....	58
Figure 19: Yellow, pink and brown varieties of <i>chuguas</i> Villa de Leyva, Colombia.....	58
Figure 20: Pink variety of <i>chuguas</i> different shapes and sizes Bogotá, Colombia.....	58

Figure 21: <i>S. phureja</i> criolla (left), <i>S. tuberosum</i> sabanera (center), <i>S. rybinii</i> rucki (right)	
Bogotá, Colombia. ....	61
Figure 22: Yuca roots at the Paloquemao produce market at Bogotá, Colombia. ....	62
Figure 23: Sweet potato of the sweet variety Bogotá, Colombia. ....	64
Figure 24: Sweet potato of the salty variety Bogotá, Colombia. ....	65
Figure 25: Burned corncob from excavations in the Muisca site of La Muela by the UPTC. ....	67
Figure 26: Corn <i>bollos</i> Barranquilla, Colombia (left). Corn <i>arepas</i> Bogotá, Colombia. ....	69
Figure 27: Archaeological site El Infiernito near Villa de Leyva, Boyaca Colombia. Muisca observatory (left). Phallic symbols indicating fertility rites (right). ....	71
Figure 28: <i>Mazorca pollo</i> variety (left). Processed corn for <i>arepas</i> or <i>bollos</i> (right) Bogotá, Colombia. ....	72
Figure 29: Quinoa grains Bogotá, Colombia. ....	76
Figure 30: Burned bean seeds recovered at the site of La Muela Tunja, Colombia by the UPTC representing the varieties: <i>Huacaloma</i> , <i>San Rafael</i> and <i>Tunja</i> . ....	78
Figure 31: Common bean <i>San Rafael</i> variety Bogotá, Colombia. ....	79
Figure 32: Chachafruto seed Bogotá, Colombia. ....	81
Figure 33: <i>Guama</i> fruits, seeds and pods Neiva, Colombia. ....	82
Figure 34: <i>Ahuyama</i> Villa de Leyva, Colombia notice the large size of the fruit (left). <i>Ahuyamas</i> at the produce market in Tunja, Colombia. ....	85
Figure 35: <i>Curcubita pepo</i> green variety Bogotá, Colombia. ....	86
Figure 36: Varieties of peppers sold at the Codabas produce market Bogotá, Colombia. ....	87
Figure 37: <i>Ají Rocoto-Capsicum pubescens</i> Bogotá, Colombia. ....	89

Figure 38: <i>Ají</i> pajarito wild species of <i>Capsicum</i> used in the preparation of hot sauces in Colombia.....	89
Figure 39: National pineapples at the Codabas market Bogotá, Colombia. ....	91
Figure 40: Goldenberries Bogotá, Colombia. ....	92
Figure 41: Goldenberries in their husk (left). <i>Dulce de uchuya</i> a traditional dessert of Colombia. ....	93
Figure 42: <i>Lulo</i> fruit <i>S. quitoense</i> Bogotá, Colombia (right). <i>Lulo</i> fruit <i>S. septentrionale</i> Neiva, Colombia.....	94
Figure 43: <i>Curuba</i> fruits Bogotá, Colombia. ....	96
Figure 44: <i>Granadilla</i> fruits Bogotá, Colombia ....	98
Figure 45: <i>Badea</i> fruit Neiva, Colombia.....	98
Figure 46: <i>Gulupa</i> fruits Tunja, Colombia. ....	99
Figure 47: <i>Chulupa</i> fruits Neiva, Colombia. ....	100
Figure 48: Avocado fruit West India variety Bogotá, Colombia.....	101
Figure 49: Avocados of the three known varieties at the Codabas produce market Bogotá, Colombia.....	102
Figure 50: Guava fruits <i>pera</i> variety (left). Guava fruits white ( <i>coronilla</i> variety), and red ( <i>pera</i> variety) Bogotá, Colombia.....	104
Figure 51: <i>Tomate de árbol</i> fruits of the varieties: <i>rojo</i> , <i>amarillo</i> , and <i>común</i> Bogotá, Colombia. ....	106
Figure 52: Custard apple fruit Bogotá, Colombia.....	107
Figure 53: Soursop or <i>Guanábana</i> fruits Neiva, Colombia.....	108
Figure 54: <i>Cherimoya</i> fruit Bogotá, Colombia. ....	109



Figure 55: <i>Papayuela</i> fruit (left and center) and <i>dulce de papayuela</i> a traditional Colombian dessert (right) Neiva, Colombia.....	110
Figure 56: Lake Iguaque in Boyaca (left). Wild <i>agras</i> berries at Iguaque (right). .....	111
Figure 57: <i>Agras</i> berries at the Paloquemao market Bogotá, Colombia.....	112
Figure 58: <i>Mora de Castilla</i> berries Bogotá, Colombia. ....	113
Figure 59: <i>Zarzamora</i> or <i>moron</i> berries (left). Size variation between the three species of <i>moras</i> largest <i>zarzamora</i> , medium size <i>mora de castilla</i> , small <i>mora silvestre</i> Bogotá, Colombia.....	114
Figure 60: <i>Mora Silvestre</i> plant and berries Bogotá, Colombia. ....	115
Figure 61: <i>Guasca</i> leaf a main ingredient of the traditional <i>ajiaco</i> Bogotá, Colombia. ....	116
Figure 62: Gold Muisca <i>poporo</i> and stick for coca (left). Coca leaves and snails used for calcium (right) Museo del Oro Bogotá, Colombia. ....	117
Figure 63: Map created by the author showing the trade of coca leaf within the Muisca territory before and during the conquest, based on information found in Langebaek (1987). ....	119
Figure 64: Coca leaf and coca plant Bogotá, Colombia.....	120
Figure 65: Domestic guinea pig pelvic bones recovered at La Muela, Tunja by the UPTC, Colombia.....	123
Figure 66: Domestic guinea pig mandibles recovered at La Muela, Tunja by the UPTC.....	126
Figure 67: Domestic guinea pig femurs (left). Domestic guinea pig humerus notice burned areas indication of cooking. La Muela Tunja, Colombia UPTC.....	126
Figure 68: Domestic guinea pig radius (left). Domestic guinea pig scapula (right). La Muela Tunja, Colombia UPTC. ....	126
Figure 69: Gold deer figurine from the Late Muisca Period Museo del Oro Bogotá, Colombia. ....	128

Figure 70: <i>Odocoileus virginianus</i> femur samples collected for collagen testing from La Muela Tunja, Colombia recovered by the UPTC.....	129
Figure 71: <i>Odocoileus virginianus</i> maxilla (left). Deer antler (right). Recovered at La Muela Tunja, Colombia by the UPTC. ....	130
Figure 72: Fox mandible recovered at La Muela Tunja, Colombia by the UPTC.....	131
Figure 73: Gold ornament of a large bird, Late Muisca period Museo del Oro Bogotá, Colombia. ....	132
Figure 74: Fishing weights of the Muisca period Museo del Oro Bogotá, Colombia. ....	134
Figure 75: Gold ornament of a capitán fish, the eel like cat fish is easily recognized for its barbells (left). Small gold fish from a Muisca necklace. Museo del Oro Bogotá, Colombia. ....	136
Figure 76: Modern town of Raquira well known for its ceramics since Muisca occupation. ....	138
Figure 77: Muisca jar (left). Muisca <i>mucura</i> (right). Museo del Oro Bogotá, Colombia. ....	139
Figure 78: Muisca jar <i>Guatavita desgrasante mucura</i> , notice the geometrical figures. Museo del Oro Bogotá, Colombia. ....	139
Figure 79: Pedestal cup dating to the Muisca Period painted outside and inside <i>Guatavita Desgrasante</i> . Museo del Oro Bogotá, Colombia. ....	140
Figure 80: Muisca <i>cuencos</i> used for serving food and drinks. Museo del Oro, Bogotá. ....	141
Figure 81: Muisca <i>ollas</i> of different shapes and styles sometimes decorated and painted (left). <i>Ollas cuenco</i> (right). Museo del Oro Bogotá, Colombia. ....	141
Figure 82: <i>Guacha</i> a type of ceramic used in the evaporation of salt. Museo de Oro Bogotá, Colombia.....	141
Figure 83: Muisca stone mano and granite metate Museo del Oro Bogotá, Colombia.....	143
Figure 84: Muisca stone axes large and small. Museo del Oro Bogotá, Colombia. ....	143

Figure 85: Muisca stone mortar and bird carved pestle. Museo del Oro Bogotá, Colombia.....	143
Figure 86: Stone sharpener (left). Jasper Atlatl (right). Museo del Oro Bogotá, Colombia.....	144
Figure 87: Muisca granite fishing weight Museo del Oro Bogotá, Colombia (right). Deer bone tools for puncturing, mixing and other functions UPTC Tunja, Colombia. ....	144

## LIST OF TABLES

Table 1: This table shows agricultural crops used by the Muisca before the conquest, common names, botanical names, varieties, origins, nutritional information, and uses for these plants. .	167
Table 2: This table uses information from Pradilla <i>et al.</i> (2005) of mammal remains recovered at La Muela and Los Altos Santuarios in Tunja, Boyaca by the UPTC. (MNI) refers to the minimum number of individuals from the skeletal assemblage. ....	175
Table 3: Weight (wt), type, and condition from mammal bone samples analyzed at the UPTC Tunja, Colombia. ....	177
Table 4: Measurements, material, munsell coloring, and function of Muisca artifacts analyzed at the Museo del Oro ceramic and stone tools deposit Bogotá, Colombia. ....	178
Table 5: Mean roots and tubers size measurements ( $\pm$ standard error) of products purchased in Cundinamarca and Boyaca, Colombia.....	179
Table 6: Mean grains size measurements ( $\pm$ standard error) of products purchased in Cundinamarca and Boyaca, Colombia.....	180
Table 7. Mean legumes size measurements ( $\pm$ standard error) of products purchased in Cundinamarca and Boyaca, Colombia.....	180
Table 8. Mean leaf size measurements ( $\pm$ standard error) of products purchased in Cundinamarca and Boyaca, Colombia. ....	180
Table 9: Mean fruits size measurements ( $\pm$ standard error) of products purchased in Cundinamarca and Boyaca, Colombia.....	181
Table 10: Mean <i>ají</i> size measurements ( $\pm$ standard error) purchased in Cundinamarca, Colombia. ....	182

Table 11: Mean *tomate árbol* *Cyphomandra batacea* size measurements ( $\pm$  standard error)

purchased in Cundinamarca, Colombia. .... 182

## CHAPTER ONE: INTRODUCTION

The Muisca people of the Eastern Cordillera of Colombia (Figure 1) had an exceptionally complex diet which is the result of specific subsistence strategies, environmental advantages, and social restrictions. The distinct varieties of microclimates, caused by the sharp elevations in this part of the Andes, allows for a great biodiversity of plants and animals that was accessible to the native population. The Muisca utilized more than 40 of these species throughout their territory and the adjacent regions for sustenance. These products have been identified through extensive multidisciplinary research (Table 1)<sup>1</sup>. Another essential product of the Muisca diet was salt. This mineral, found in the mines of Zipaquirá and Nemocón in Muisca territory, was highly desired and traded within the region and the adjacent territories for items not locally produced, thereby increasing the access to other varieties of food. Nevertheless, the Muisca diet was limited by the variety of foods they had access to and by the social processes that developed into restrictive dietary practices imposed by the elite.

This dietary stratification is most evident in the consumption of corn and animal protein, especially deer, which was restricted to the chiefly classes except during feasts and other celebrations when the entire social strata had access to these foods. The majority of food products used by the Muisca before the Spanish conquest is still very much a part of the modern Colombian diet and in some ways remain restricted to specific social classes, as will be explained in this thesis. Our understanding of the modern uses of these products can facilitate our interpretation of the archaeological data. The purpose of this research is to establish a

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<sup>1</sup> The earliest presence of plant domestication in the Muisca plateau comes from the site of Aguazuque where remains of domesticated varieties of *Curcubita pepo* (calabaza) and *Oxalis tuberosa* (ibias) dating to 3850+/-35 BP were recovered (Correal, 1990:261).

reconstruction of the Muisca diet and to identify products used for food by this society through the analysis of the archaeological data, ethnohistory, ethnology, and ethnobotany of this region in the Colombian Andes.

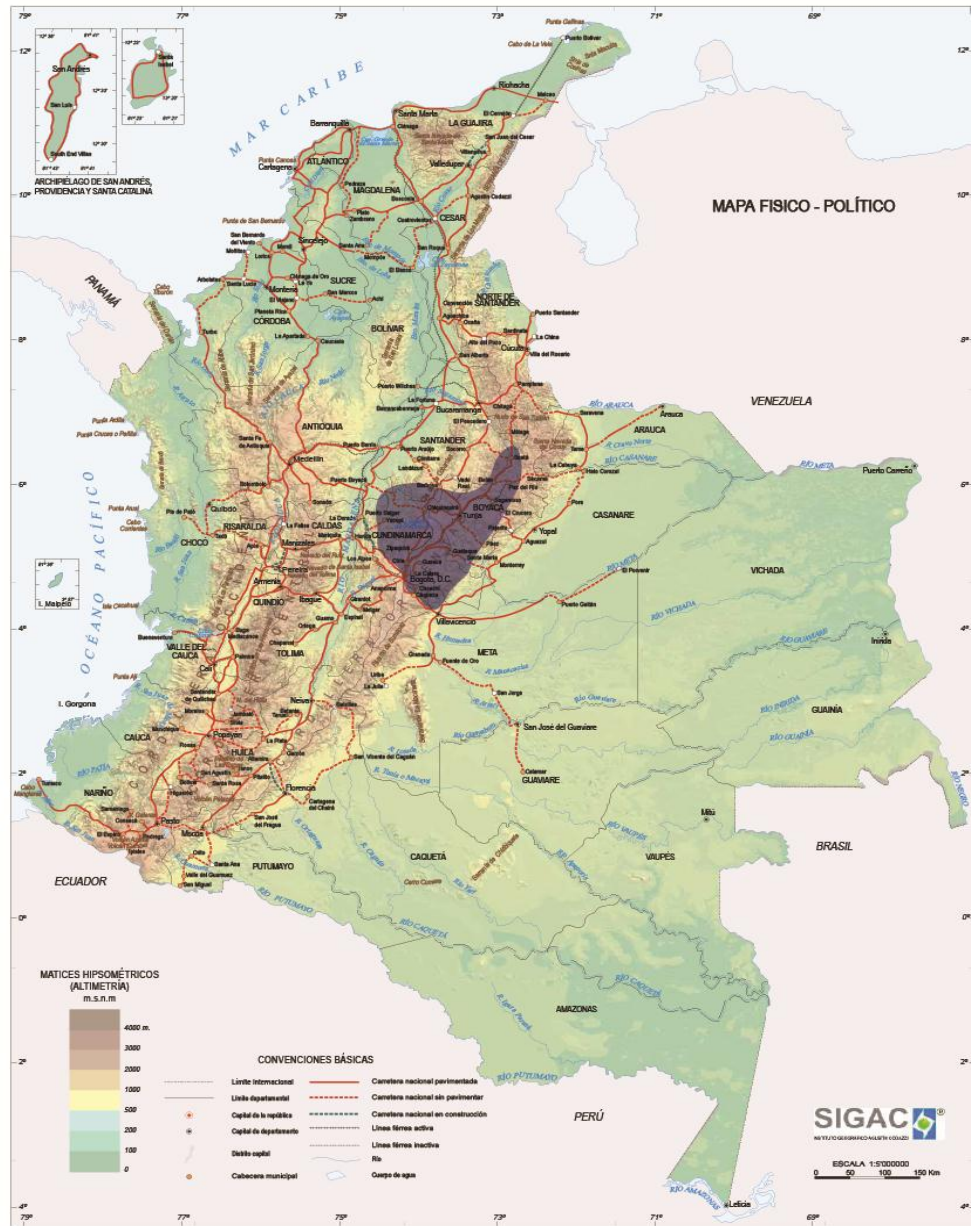


Figure 1: Chiefdoms of the Northern Andes. Darker purple area shows the Muisca territory at the time of the Conquest (map courtesy of the Instituto Geográfico Agustín Codazzi Bogotá, Colombia Appendix A).



Dietary analysis is a fundamental tool used by anthropologists in order to understand the cultural developments of New World societies. The study of what people eat and how they obtain their food lends insight into behavioral and cultural practices (Tykot 2006). Differences between the diets of specific human groups are the direct result of different subsistence strategies, environmental constraints, and cultural constructs. These shaping factors are evident when a society evolves from a hunter-and-gatherer society into an agricultural society (Johnson and Earle 2000). “The major subsistence event underlying rank society is the transition to a domesticated food supply” (Fried 1967: 115). Such “cultural developments often bring social stratification, which in turn leads into a preferential diet for the favored individuals” (Lambert *et al.* 1984: 298). The preferential and restrictive diets are established to maintain boundaries and social control in the form of “sanctions, rewards, or punishment used by an individual group to lead or confine within stated channels the behavior of others” (Fried 1967: 10). This change is often the result of dietary differences within and between cultural groups and can be measured as a correlation between diet and social stratification. For instance, Ambrose, Buikstra and Kruger (2003) have demonstrated how a preferential diet of the Mississippian culture in Cahokia, Illinois is correlated to status and gender differences. Chase and Chase (2001) have showed that the Maya elite living in the palaces of Caracol ate a distinct diet high in both maize and animal protein. By identifying the differential dietary practices of a cultural group, it is possible to understand important factors in the development of a group’s social stratification strategy.

Reconstructing the diet of a human society is a complex process, especially for archaeologists who lack the ability to see these practices first-hand and must rely on multiple interdisciplinary methods to successfully identify lost dietary practices. New World archaeologists trying to reconstruct ancient diets have relied on a variety of data: the analysis of

human food remains, and tools to process foods; the iconography of artifacts depicting food; pollen analysis; phytoliths; coprolites; dental wear patterns; and, most recently, chemical analysis of human and animal bone, such as stable isotope analysis and starch recognition (Ambrose *et al.* 2003; Correal 1983; Cárdenas-Arroyo 1993, 1995, 2002; Pradilla *et al.* 2005; Chase and Chase 2001; Dupras 2001; Emery 2000). Processual archaeologists have also relied on ethnographic studies and colonial European chronicles to make cross-cultural comparisons between the diet of past and modern societies. New World archaeologists also consult ethnobotany studies, which are an important source of biological data of the plants used by a given society<sup>2</sup>.

Archaeologists trying to reconstruct the diet of ancient cultures in the Americas commonly focus on the areas where the most advanced complex societies in the New World occurred: Mesoamerica (Emery 2000, 2003; Teeter and Chase 2004); the Peruvian and Bolivian Andes (Ambrose *et al.* 2003); and the Mississippi valley (Finucane *et al.* 2006.) However, these studies often ignore areas of primary plant domestication like the Amazon basin (Walker 2011) and the Colombian Andes (Dolmatoff 1965). This misbalance of archaeological research has led to the misconception that all the social processes that motivated the domestication of plant and animal species developed in the mentioned geographical areas and spread to the rest of the continent, such as was the case with corn. One of these forgotten regions is the country of Colombia, the entrance to the South American continent (Lavallée 1995). Recent archaeological interpretations demonstrated that the domestication of New World species are not only the result of the diffusion of cultural practices from large cultural centers, but are also the result of independent temporal and spatial developments (Lathrap 1973, 1975). Colombia is probably one

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<sup>2</sup> Ethnobotany is the scientific study of the relation between plants and humans.

of the regions where the independent domestication of certain plants and animals occurred, as well as the region where Mesoamerican domesticated crops were first adopted by South Americans (Cárdenas-Arroyo 2002). Recent anthropological studies in Colombia are changing our perspective of the cultural processes that led to the independent domestication and adoption of food products that were ignored in the past. As stated by (arguably) the most important Colombian anthropologist Reichel Dolmatoff (1965: 15): “The study of Colombian Prehistory has been overshadowed by the splendor of the ancient civilizations of Mesoamerica and the Central Andes,” an issue currently being addressed.

The nonconformity expressed by Reichel Dolmatoff is understandable since some of the earliest pottery in the continent (3000 B.C.) was found in Colombia (Reichel Dolmatoff 1965: 54), as well as some of the earliest evidence of corn agriculture (4000 to 3000 B.C.) (Cárdenas-Arroyo 2002: 14; Tykot 2006; Bray *et al.* 1987: 445). In Colombia the earliest and some of the most advanced complex societies in South America developed (Carneiro 2000; Drennan 1991), and goldsmith technology reached its peak (Reichel Dolmatoff 2005), making this region particularly influential in South America. Studies defining the diet of indigenous societies in Colombia are important as there is evidence of independent domestication or early adoption of food products such as corn (*Zea mays*), yuca (*Manihot esculenta*) (Reichel Dolmatoff 1965: 62), the *arracacha* (*Arracacia xanthorrhiza*) (Sauer 1950), and the guinea pig (*Cavia porcellus*) (Ijzereet 1978; Cárdenas-Arroyo 2002). Understanding the dietary practices of early Colombian societies will give us a more accurate representation of how agriculture was first adopted by South American hunters-and-gatherers and how human groups developed into the stratified complex societies that the Spanish encountered during the conquest.

One of these advanced human societies of great importance encountered by the conquistadors in Colombia was the Muisca<sup>3</sup>. The Muisca were part of the Chibchan language group, consisting of five independent chiefdoms (Figure 2) who shared a unified culture. The Muisca inhabited the plateau in the Eastern Cordillera of the Andes, where the modern cities of Bogotá and Tunja exist today (Figure 1). “Their settlement area, which can be relatively well reconstructed on the basis of the chroniclers’ reports, spread out over about 22,000 square kilometers” (Kurella 1998: 192). The Muisca population is estimated to have surpassed 500,000 people during the Spanish conquest (Reichel Dolmatoff 1982a: 97). Radiocarbon dating supports a Muisca presence in this region from AD 1000 +/- 200 up to the Spanish conquest (ca AD 1600’s) (Labbé, 1986). This region is a fertile highland basin packed with resources and biodiversity that the Muisca exploited to its fullest potential. Some of these resources include: a variety of fruits and edible plants such as: sweet potato, beans, peanuts, squash, corn, *achira*, *yuca*, potatoes, *arracacha*, quinoa, peppers, *oca*, *cubios*; animals such as guinea pig and deer; mineral resources, like salt used for consumption and trade; and, emeralds, stones that were also traded.

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<sup>3</sup> For a comprehensive description of Muisca culture in the English language see Kurella (1998).



Figure 2: Map showing the domain of the Muisca before the conquest. Segmented lines show the limits of each of the five Muisca chiefdoms. Map created by the author from information in Rojas (1977).

### Overall Aims and General Questions

Three main questions are addressed in this research. (1) What did the Muisca people eat and how did they obtain their food? (2) What methodologies can be used to reconstruct the diets of the Muisca people? (3) Did this complex chiefdom have a restrictive diet for lower social classes and, if so, what were the restrictions of this diet? In order to answer these questions I analyzed the archaeological evidence, the ethnohistory, ethnographic studies and the ethnobotany of the territory once inhabited by the Muisca, that today includes the modern cities of Bogotá and Tunja, Colombia. Although data relating to the diet of Colombia's ancient societies are scarce (Cárdenas-Arroyo 2002: 13), there are some studies that have used a variety of archaeological methods to interpret the ancient dietary practices of the Muisca and other indigenous groups affiliated with this society. The Spanish chronicles describe some of the cultural practices of the Muisca and are a valuable asset to our understanding of this group and its dietary practices. There are also a variety of studies that use the ethnographic method to interpret the diet of modern societies (ethnobotany) that still use some of the same food products the Muisca used before and during the conquest, demonstrating how such products were used by this complex Pre-Columbian society.

The Muisca diet was very complex because the stepped elevations in the portions of the Andes that the Muisca inhabited creates various microclimates that result in a great diversity of plants and animals. The availability of the microclimates that ranged from sea level to elevations greater than 4,000 m. allowed the Muisca to exploit and domesticate a great variety of plants and animals. "Since ancient times Colombia's mountain valleys, with their innumerable microclimates, have been an ideal laboratory for plant and animal domestication" (Reichel Dolmatoff 1965: 18). The purpose of this research is to develop an accurate reconstruction of the

Muisca diet and its effects on the distinct social classes of this group that led to the formation of a preferential diet for the elite and dietary restrictions for the lower social classes. I also try to identify and describe those foods used by the Muisca that are still utilized as part of the modern Colombian diet, especially where social divisions in access to specific foods are visible today.

## CHAPTER TWO: REVIEW OF THE LITERATURE

There is a lack of archaeological, ethnographic, and ethnobotanical research that focuses on the dietary practices of the Muisca and modern Colombians in the English language. The majority of the following sources described here were written in Spanish.

### Archaeology

The Muisca sites known in Colombia as El Cercado de Los Altos Santuarios and La Muela North of the modern city of Tunja (Figure 3) were used as the basis of the archaeological evidence for this project. These sites were excavated by a group of archaeologists from the Universidad Pedagógica y Tecnológica de Colombia (UPTC) in Tunja between 1986 and 1995. They were selected here because of their significance for the Muisca and the fact that there is an impressive preservation of human bone, animal bone, and plant material (rare for Colombia), as well as a high number of utilitarian artifacts related to food production and consumption, all ideal elements for a dietary reconstruction project. The majority of the information about the excavations and research from these sites are still unpublished and this information was acquired mainly from unpublished reports on the excavations performed by the UPTC at these sites and one published article (Pradilla *et al.* 2005). Stone tools and ceramic artifacts from the “Ceramic Deposit” at the Museo del Oro were also analyzed in order to understand the processing and forms of consumption of foods by the Muisca. Information about these artifacts, located at the “Ceramic Deposit” at the Museo del Oro, has not been published. Special permits were required to access this collection and collaboration with the staff at the Museo del Oro was essential to facilitate the analysis of this material.



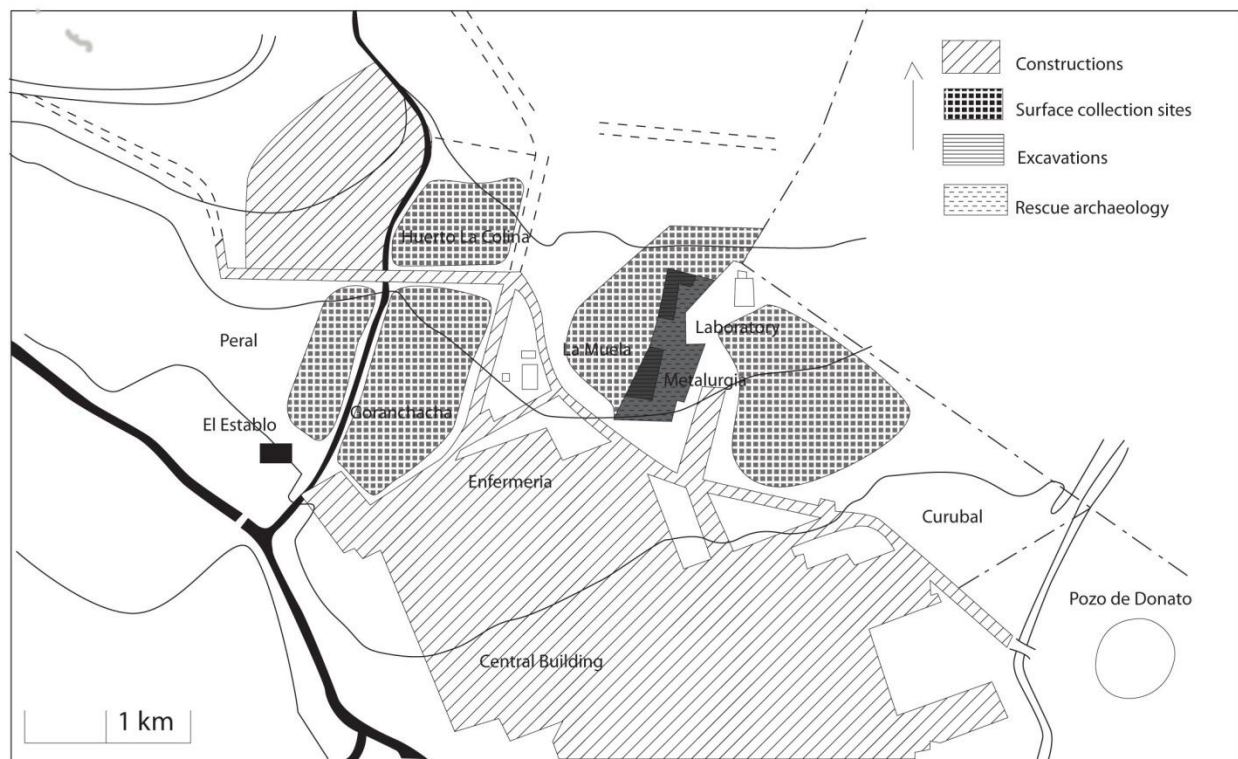


Figure 3: General map of the archaeological sites of Los Altos Santuarios and La Muela UPTC. (Based on information by Pradilla *et al.* 2005).

The Los Altos Santuarios and La Muela sites contain more than 55 human burials that range from highly complex to very simple<sup>4</sup>, some containing food offerings. Pradilla, Villate and Ortiz (2005) studied the dental wear patterns of individuals found in the complex burials versus dental patterns of individuals occurring in simple burials and found great differences, suggestive of a difference in the diet of specific social classes. Excavations in Tunja, resulted in the recovery of a large amount of artifacts used for processing food that still contain food remains and include: pottery; stone tools cutting tools; manos and metates; and arrow points.

<sup>4</sup> Simple burials are considered those without any ritual offerings. Complex burials are referred to those with elaborate ritual offerings that include pottery vessels, gold ornaments, stone offerings, shell, etc. The more elaborate or numerous the offerings the more complex the burial.

Excavations at La Muela, resulted in the recovery of seeds of various plants, animal bones, and carbonized corn. In Los Altos Santuarios and La Muela archaeologists have recovered more than 3,500 faunal bones representing at least 14 species of mammals and 7 species of birds, the majority showing evidence of human consumption (Table 2). There is also evidence in La Muela of a large number of domesticated plant species that include corn, potatoes, beans, and a variety of unidentified species. The material analyzed at the Museo del Oro also includes utilitarian stone tools and ceramic artifacts utilized in the processing, serving, and consumption of food products.

The most comprehensive archaeological research on the Muisca diet and the diet of earlier inhabitants in this region is the work of Felipe Cárdenas-Arroyo (1993, 1995, 2002, 2005). His research focuses on the use of Carbon and Nitrogen stable isotope analysis on human bone and dental wear patterns of ancient hunter-and-gatherers and agricultural populations that inhabited the Bogotá Sabana. This research shows a chemical difference in the diet of early Paleo-Indian populations and later Muisca populations in the Bogotá Sabana as well as the differences between the diet of individuals in terms of corn consumption and intake of animal protein (Cárdenas-Arroyo 1993, 2002). This author has also identified the consumption of plants by the Muisca such as: quinoa (*Chenopodium quinoa*); *ibias* (*Oxalis tuberosa*); arracacha (*Arracacia xanthorrhiza*); beans; potato; yuca; calabaza (*Cucurbita pepo*); sweet potato (*Ipomea batata*); Totumo (*Crescentia cujete*); and, the consumption of mammals such as guinea pig and deer. This research has been crucial for our understanding of the Muisca culture and their dietary practices; however, it focuses mainly on the stable isotope results of Paleo-Indian and pre-Muisca diets and is not a comprehensive dietary reconstruction of the Muisca foods.

Jose Rozo Gauta has also greatly contributed to our understanding of the Muisca diet (1998). His book *Alimentación y Medicina entre los Muiscas* Rozo describes not only products, but also methods of preparation and consumption of food products. Rozo also conducted linguistic research on the terminology used by the Muisca when referring to food products, methods of preparation, and the act of eating. Reichel Dolmatoff (1965) has suggested that the Muisca grew at least two types of potatoes, quinoa, *ulluco*, *oca*, *topinambur*, and *cubios*. Doris Kurella (1998) describes Muisca society and posits the existence of a restrictive diet, proposing that the consumption of deer was restricted to the chiefly class.

Other authors including Henderson and Ostler (2005), Villamarin and Villamarin (1975), Glassner (1970), Haury (1953), and Langebaek (1994) have also described important theories and products of the Muisca diet. Herrera (2005) has conducted pollen analysis of the site Buritica-200 inhabited by the Tayrona chiefdom; it was culturally similar to the Muisca and in an area where the Muisca shared some of the same food products. Boada and Berrio (2006) conducted pollen analysis of the Muisca sites of Guaymaral and Filomena in Suba, Colombia and identified a great variety of eatable species of plants at these sites. Bray, Herrera, Cardale, Botero and Monsalve (1987) conducted pollen analysis of the Calima chiefdom, also of the Colombian Andes, obtaining the earliest evidence for corn domestication in Colombia. Parra (1998) conducted phytolite studies recovered from the dental plaque of Muisca human remains and identified three plant species used for food: *Zea mays* (corn); *Canna edulis* (achira); and *Curcubita pepo* (calabaza). Phytolith recognition of modern plants for comparison to archaeological material were established in the paper: *Nutrición y Alimentación de la Población Arqueológica de Tunja: Estudio de Fitólitos* (Bravo et al. 2005)

Langebaek (1987) conducted research establishing the ethnic integration of markets within and outside Muisca territory, defining food products and methods of distribution by the Muisca and their trading partners. By observing the iconography and the faunal osteological material of Muisca sites, Legast (1995) has identified and described in detail the species composition of the fauna present in Muisca territory that in many cases formed part of the animal protein diet of these chiefdoms. Salt was another important part of the diet of the Muisca. The Muisca controlled the large salt mines of Zipaquira and Nemocón, extracting this important mineral for consumption and trade (Herrera and Cardale 2000). Salt and other foods were also traded within the Muisca chiefdoms. Cardale (1981) intensively studied the salt production and trade through excavations and extensive research at the salt mines of Zipaquira. In *Las Salinas of Zipaquira Su Explotación Indigena*, Cardale not only describes the methods of production and distribution of this mineral, but also elaborates on the traditions, typology, and sequencing of ceramics recovered at Zipaquira that were utilized in the production of salt, other utilitarian uses, and ceremonial practices.

There are a number of publications focusing on the traditions, function, sequencing, and chronology of Muisca ceramics. Analysis of Muisca and pre-Muisca ceramics has been undertaken by a large group of researchers for over five decades. Reichel-Dolmatoff (1965) described the few ceramics (potsherds) recovered in the vicinity of Tunja, but emphasized that during the 1960's, "nothing is known of the burial or pottery associations". This lack of information began to change with the research of Sylvia Broadbent (1971, 1974) who developed the first sequences and chronology for pre Muisca and Muisca ceramics. Broadbent established the typology of Muisca ceramics and, although some new types have been added by more recent studies, the majority of the types described in her research are still the fundamental basis for

Muisca ceramics. Cardale (1981) has also established important types and sequences for Muisca ceramics and has collaborated with Paul de Peape (1990) in an analysis of ceramics from the Herrera period. A comprehensive and accurate description of the typology and chronology of Muisca ceramics has been developed by the research of Carl Langebaek (1995). Langebaek describes the ceramic types of all the Muisca periods and establishes precise chronologies with the use of radiocarbon dating of material excavated with specific ceramic types. In terms of descriptions on the function and decoration of Muisca ceramics, the work by Rojas de Perdomo (1977) is an important contribution to the literature. Alejandro Patiño (2003) another Colombian archaeologist, has studied the change of Muisca domestic activity of residential units over time in the Sabana de Bogotá. Patiño demonstrates in this research that “the use of ceramics focuses on the serving and preparation of foods, and not centered in the use of ceremonial activities” (2003:138). These archaeological sources are not the only type of evidence we have on the diet of the Muisca; fortunately, the Spanish conquistadors and Catholic priests left written documents of the traditions and practices of this complex society.

### Ethnohistory

The arrival of the Spanish conquistador Gonzalo Jiménez de Quesada to the Sabana de Bogotá territory in 1536 represents the first European contact with the Muisca chiefdom (Kurella 1998, and Labbé 1986). Jiménez de Quesada intended to search for “El Dorado,” a legendary treasure believed to be located in Muisca territory<sup>5</sup>. This conquistador reached the land of the

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<sup>5</sup> The legend of El Dorado was born in Muisca territory where is said that the Muisca chief covered himself in gold dust and in a canoe went to the middle of the Lake Guatavita. The chief immersed himself in the water. Reichel Dolmatoff believes that this Muisca practice began after a meteorite fell at Guatavita. “A golden god had descended and had chosen his abode in the depths of this land. This, then, is the powerful sprit which dwells at the bottom of

Muisca by following the salt trade to the northern regions of Colombia from the salt mines of Zipaquirá and Nemocón, which the Muisca controlled (Herrera and Cardale 2000). After the arrival of Jiménez de Quesada and his troops, other conquistadors and priests followed him to this territory and began to write in Spanish descriptions of the Muisca society and their cultural practices. Jiménez de Quesada wrote an important account on the Muisca where he describes various aspects of the culture including alimentary practices (1962 [1545]). Various primary sources of Spanish accounts of the Muisca are located in the Archivo Nacional de Colombia in Bogotá (ANC) such as the *Visitas de Boyacá* (1601) which describes the encomienda of Martín Rojas in Tunja. The ethnohistory of this region has also been augmented by modern publications of chronicles dating to the conquest. The most significant of these sources was written by Fray Pedro Simón (1981 [1625]) and discusses in detail the consumption of foods and the social organization and complexity of Muisca chiefdoms<sup>6</sup>. Other sources located at the section of Rare Books and Manuscripts of the Luis Ángel Arango library include ethnohistoric research by Ramón Alberto García (1948), Fray Alonso de Zamora (1980 [1701]), Gregorio Hernández de Alba (1948), Fray Lugo Bernardo (not date), and Ezequiel Viricoechea (1871), all which contain information regarding Muisca practices in terms of the utilization of food products. In order to successfully reconstruct the Muisca diet it is wise to examine the modern cultures that continue to use some of the same foods that the Muisca procured in order to draw analogous comparisons.

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Lake Guatavita and this is what the gilded cacique symbolizes when he dives into the waters to acquire the power to lead his people” (1965).

<sup>6</sup> see also Mojica Silva and his *Relación de Visitas Coloniales* 1948, and Zamora, Fray Alonso 1980 [1701].

### Ethnography and Ethnobotany

“Ethnographic study of land use and local history is a powerful methodology that is particularly effective in conjunction with archaeological investigations” (Walker 2011: 6).

Gerardo Reichel Dolmatoff (1982b) constantly demonstrated the importance of cross- cultural comparisons between past and modern Colombian indigenous societies as shown in his research on the ancient Tairona and their modern descendants, the Kogui of the Sierra Nevada. Dolmatoff discovered that the Tairona buried pottery vessels below household floors, but the significance of this activity was unknown. To Dolmatoff’s (1982) surprise the Kogui also buried ceremonial vessels in their house foundation adding small pebbles inside the vessel that represented each member of the household. Miniatures of grinding stones and mullers are often found in Tairona sites as well as among the modern Kogui who use them to grind necklace beads which represent food for ancestral spirits (Reichel Dolmatoff 1971). “These few examples, then, not only show the remarkable continuity of Tairona culture, but are ample proof of the many clues ethnographic parallels can provide in the interpretation of otherwise problematic archaeological finds”

(Reichel Dolmatoff 1965: 48). Dolmatoff also examined the Desana of the Colombian Amazons. His research showed how social restrictions and taboos in hunting facilitated an ecological balance in this area. The Muisca may have also attained such an ecological balance as they also maintained social restrictions on hunting practices (Reichel Dolmatoff 1971, and Kurella 1998).

The most important dietary analysis of past and modern Colombian societies is the research of Victor Manuel Patiño. In his *Historia de la Cultura Material en la America Equinoccial: Alimentación y Alimentos* (1990-1993) this author describes how social hierarchies were not only represented in clothing and burial practices but also in the diet. Patiño (1990-1993) suggested that the Spanish nobility in the New World would eat the domesticated birds and the

most desirable cattle meat cuts but left the *viceras*, such as the tongue, the tripe and liver to the commoners and the Indians. Patiño (1990-1993) also describes some aspects of the preferential diet practiced by the Muisca, such as the limitations on deer consumption and the limitations and restrictions on the preparation of corn. Elites consumed the processed corn in the form of *arepas*, which are grilled, whereas *bollos* which are boiled were consumed by the lower classes<sup>7</sup>. In this work Patiño describes Pre-Columbian dietary practices and compares them to later practices found during the conquest and in modern societies in Colombia, always emphasizing how social stratification is correlated to preferential diets in these three time periods. Luisa Fernanda Tobar and Myriam Chinchilla (1996) have also conducted research on the modern dietary practices of Colombian indigenous societies and explain how products previously used by the Muisca, such as guinea pig, *achira*, quinoa, *arracacha*, *ibias*, are still very much part of the modern Colombian diet.

For information on the ethnobotany, I will mainly use a report published by a panel named “Advisory Committee on Technology Innovation Board on Science and Technology Development” (ACTIBS) (1989) on the food crops of the Andes. In this report various plant foods that were used by the Muisca are biologically and generally described, including their current and sometimes ancient use, their nutritional values, agronomy, environmental limitations, taxonomic descriptions, origin, and their common names in distinct regions that include Colombia. Most of the plant food products that are mentioned in the archaeology and the ethnohistory of the Muisca are described in this thesis in detail, as well as being illustrated and photographed which is essential for this research. This thesis also describes how some of these

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<sup>7</sup> *Arepas* are prepared by drying the corn, then preparing cornmeal that is made in to thick round disks that are later grilled. Are eaten in every region in Colombia . *Bollos* or *envueltos* also made of cornmeal are wrapped in the cornhusk and boiled. These are similar to the Central American *tamales*.



products are still perceived by the upper modern social classes in the Andes as “Indian food” and are still in a way determinants of social status as much as was the deer for the Muisca (ACTIBS 1989).

Acosta and Moreno (1997) have described in great detail the modern uses, quantity of consumption and production, nutritional values, areas of production, and the economic benefits and difficulties of native root crops in the Muisca territory. In a different publication Acosta and Moreno (1991) describe, with the same detail as their work with root crops, the native fruits of Cundinamarca and Boyaca regions that were previously inhabited by the Muisca. Bravo, Manrique, Pradilla, Acuña, and Morales (2005) developed a detailed list and ethnobotanic description of eatable species that are native to the Muisca territory, with an entire section dedicated to the root *achira* (*Canna edulis*). Rozo (1998) has also made important contributions of the ethnobotany of a variety of products utilized by the Muisca. It is also important to understand the changes that occurred in agricultural production from the Muisca period through the Colonial period and into modern times, aspects which have been successfully explained by Juan Villamarin (1975). There are also important descriptions and the history of domestication of tropical fruits cultivated and gathered by the Muisca (Smith *et al.* 1992, 2007). Culinary books referring to the traditional dishes of Colombia can also be of great aid in understanding the utilization of Muisca food products by past and modern populations. There are varieties of traditional dishes that use multiple Muisca products in their recipes. The most important of these dishes are the *Cocido Boyasence* and *Ajiaco* both which contain a wide variety of Muisca root crops, herbs, and cereals. There are also wide varieties of desserts that contain fruits that are native to the Muisca region, recipes that are described in this type of books (Diaz *et al.* 2008, Wills and Valencia 1996).

## CHAPTER THREE: THE MUISCA

### Geography and the Environment

The Muisca are reported to have controlled over 22,000 square kilometers (Kurella 1998: 192) in the Altiplano Cundiboyasense of what are today the Departments of Cundinamarca and Boyaca, Colombia (Figure 1). This area lays in the Eastern Cordillera of the Colombian Andes. The inhabitable area occupied by the Muisca range in elevations between 1,800 m. above sea level up to 4,500 m above sea level, although the zone has areas with elevations that exceed the 5,000 m above sea level (Langebaek 1995: 49). The Muisca also had a range of influence in areas with lower elevations, especially given the fact that this group traded with societies that inhabited areas in the coast. In order to differentiate the climatic zones in this region, geographers have utilized the terms of *tierra caliente* (0-800 m above sea level), *tierra templada* (800-1,800m), *tierra fria* (1,800-3,500) and *paramo* (3,500 m and higher). These climatic zones vary greatly not only in the geography but also in the types of environments and species of plants and animals.

The areas of major importance for the Muisca with the strongest Chieftains, were the Sabana de Bogotá (Boada 2006: 21), and the highland basins of Tunja (Kurella 1998: 192), encompassing an area of 935 square kilometers. The Sabana de Bogotá (2,500 m above sea level) is an enormous plateau that extends throughout Cundinamarca and is surrounded with a mountain chain that reaches the *paramo*. Tunja in the department of Boyaca is at an elevation of 2,840 m above sea level, although some surrounding areas reach *paramo* elevations as well. These formations occurred geologically between five million and three million years ago (van der Hammen *et al.* 1973: 90). Langebaek (1995) offers a descriptive account of the geological

features of these regions, definition of soil types throughout the various formations, and specific types of vegetation for each of the soilscares presented. The vegetation types encountered in this region are essential for understanding the native crops and species available for human consumption.

The Sabana de Bogotá and Tunja have relatively easy access to lower elevations of the Magdalena valley and a great diversity of climates and ecological zones a few hours away (Boada 2006: 21). Temperatures in this area range from 13 °C to 4 °C at night and rainfall averages 800 mm (Langebaek 1995: 52). Some areas in Cundinamarca and Boyaca can have substantially lower amounts of rainfall, such as the Candelaria desert in Valle de Leyva. There are two rainy seasons each year, the first between March and May and the second between September and November (Langebaek 1995: 53, Boada 2006: 21). The Departments of Boyaca and Cundinamarca have important sources of fresh water, which were essential for Muisca agriculture and fishing. In Boyaca the most important water source is the Chicamocha river and the Tota lagoon; in Cundinamarca at the Sabana de Bogotá it is the Bogotá River. Although today the Bogotá River is highly polluted by sewer, industrial, and agricultural residues, it was once source of water and plentiful fish for the Muisca (Boada 2006: 23).

#### Periods of Human Occupation in Cundinamarca and Boyaca

The archaeological periods of occupation in Bogotá and Tunja encompass a period of 10,000 years. The delimitations of these periods were established based on the ceramic distribution and typology in the stratigraphic layers and their correlations with associated carbon dates. Ceramic sequences using diagnostic types for each period have been established, facilitating the correlation between the areas of occupation and their chronology.

## Preceramic Period

The Preceramic Occupation (10,000 BC-400 BC) (Langebaek 1995) is divided by some archaeologists into the Paleo-Indian (10,000 BC-2050 BC) and Archaic (2050 BC-400BC) periods (Henderson and Ostler 2005). This time span is usually identified with the use of carbon dating techniques on remains of carbon mixed with soil and stone tools associations (van der Hammen *et al.* 1966). Using stone tools as the main indicators for this period is problematic as explained by Langebaek (1995: 69): “Stone tools in the Eastern Highlands from preceramic times have proven difficult to compare with stone tools from later occupations”.

The site El Abra has calibrated (*cal*) carbon dates of 9340 +/- 40 BP (van der Hammen *et al.* 1966). The site of Checua in the municipality of Nemocón, Cundinamarca was dated utilizing vegetal carbon to *cal* 7400 BC-*cal* 6440 BC (Cardenas-Arroyo 2002: 30). There is evidence that stone tools were utilized for butchering deer and guinea pig meat and processing seeds and tubers at this site (Groot 1995: 54, Hurt *et al.* 1972: 1107). The sites of Tequendama and Potreroalto Cundinamarca also show evidence of guinea pig and deer consumption and were dated with the use of vegetal carbon, as well as human and faunal bone, to *cal* 6130 BC – *cal* 4850 BC for Tequendama and *cal* 5,750 BC – *cal* 4,725 BC for Potreroalto (Cardenas-Arroyo 2002: 30). The site of Aguazuque in Soacha, Cundinamarca was carbon dated through human osteological remains and two periods were established for the site (Cardenas-Arroyo 2002: 31). The first period dates to *cal* 3925 BC – *cal* 2240 BC and the second to *cal* 900 BC – *cal* 825 BC (Correal 1990). As with all the previous sites mentioned for the preceramic period, this site contained faunal remains that include guinea pig and deer and stone tools for butchering the, demonstrating the importance of these two mammals in the pre Muisca diet that possibly led to the eventual domestication of the guinea pig and control over the consumption of deer.

## The Herrera Period

Also known as The Formative Period (Henderson and Ostler 2005: 149), the ceramic diagnostics from this pre-Muisca period are usually present in the majority of sites later occupied by the Muisca. These include sites at: Zipaquira (Cardale 1981), El Infiernito (Salge 2007), El Venado (Boada 1998), La Muela and Los Altos Santuarios (Pradilla *et al.* 2005), Valle de Fuquene (Langebaek 1995), Cota and Suba (Boada 2006). It is for this reason that this section will focus on the ceramic typologies identified for this period and not the sites where they have been recovered. The Herrera Period has been chronologically placed between 400 BC – 1000 AD (Henderson and Ostler 2005: 149). Langebaek (1998: 72) proposes dates between 800BC – AD 800 suggesting earlier dates assigned to this period are unreliable. In terms of the social organization of this period, there is not enough data to support central political organization, but there are indications that point to the existence of at least two types of social classes (Langebaek 1995: 72) and population approximations of 10,000 people (Cardale, 1981: 154). The presence of social stratification during the Herrera period is associated with distinct social status and roles between members of the society, although determining specific roles and status of any given individual during this period is complicated. Each member “certainly plays a number of roles and occupies a variety of statuses during his lifetime usually within relatively brief time spans.” (Fried 1967: 29). The establishment of social hierarchies during the Herrera period is not completely understood, nevertheless during this period, social stratification becomes evident and it is the direct result of an increase in population associated with the introduction of agriculture.

There is evidence for corn cultivation during the Herrera Period (AD150) in the form of pollen analysis (Cardale 1981: 157) and phytoliths (Correal and Pinto 1983). There is also evidence for squash (*Curcubita pepo*) and *ibias* (*Oxalis tuberosa*) indicating the importance of

these products even before Muisca occupation (Correal 1990: 261). The production of salt, especially in Zipaquira and Nemocón, was of extreme importance during the Herrera Period and the majority of the ceramics dating to this period were utilized in the processing of salt (Cardale 1981).

Broadbent (1971; 1974) first identified the diagnostic ceramics from this period through superficial survey and collection in the site La Herrera, Cundinamarca, where this period takes its name. The most common ceramic type of the Herrera Period has been named Mosquera Crushed Rock (*Mosquera Roca Triturada*), and typically, was utilized for domestic functions and produced locally (Broadbent 1971, Cardale 1981, Langebaek 1998, Boada 1998). The forms for this type are: bowls, slipped bowls, vases with neck, and *ollas*. Mosquera Red Incised (*Mosquera Inciso Rojo*) is a red slipped type with and considered an exchange item (Cardale 1981: 69, Boada 1998: 64); it is relatively uncommon. Similarities of the volcanic rock sediments in the *Mosquera Inciso Rojo* with the sediments in the modern ceramics produced at La Chamba, Tolima (Figure 4), known as a pre Columbian ceramic center, indicate that this type of pottery was produced in this region (Cardale and Paepe 1990: 103). Forms for this type are bowls and vases with necks (Broadbent 1971: 193), also indicating functions for cooking and serving.



Figure 4: Modern ceramics from La Chamba, Tolima (left). Artisan at his workshop at La Chamba, Tolima near a clay oven (right).

*Zipaquira Desgrasante de Tiestos* (*Guatavita Desgrasante Tiestos* by Broadbent 1971) replaces *Mosquera Roca Triturada* around AD 850 and was fired with temperatures exceeding 650° C (Cardale and Paepe 1990: 106). This type is especially useful for dietary analysis of phytoliths, as they are present in large amounts facilitating the identification of specific botanical species present in the ceramics (Cardale and Paepe 1990: 106, Parra 1998: 7). Forms include serving cups, bowls, *ollas*, and vases with anthropomorphic figures (Broadbent 1971: 198). *Zipaquira Desgrasante de Tiestos* also comes in a variety of forms exclusively utilized for salt processing, such as bell-shaped vases, bowls, and miniature bowls that were used to boil salt water in order to gain salt. The ceramics were then broken leaving behind the bricks of salt for consumption and trade (Cardale 1981: 112).

## The Early Muisca Period

The Early Muisca Period (AD 1,000-AD 1,200) was characterized by the formation of political organizations in the form of chiefdoms, the introduction of decorated serving vessels for the consumption of *chicha*, evidence of feasting, the increase of settlement areas, the beginning of mummification practices, and the introduction of gold artifacts for offerings and as indicators of personal status (Henderson and Ostler 2005: 149) (Figure 5). Langebaek (1998: 87) notes that there is not enough evidence to demonstrate that these events occurred during the Early Muisca Period, stating that “little is known about how was the population like in terms of social organization and economic activities”. However later he stipulates that there was a population growth, increased social competition, and an intensification of warfare and feasting during this period (1998: 89). It has been argued that this period shows a cultural continuation of the Herrera Period based on the ceramics (Castillo 1984: 202). Dramatic changes in the cultural practices between the Herrera and Early Muisca Periods may possibly indicate an invasion/migration from other areas, probably the North Coast, given the similarities in the pottery of these regions (Langebaek 1998: 87). The majority of research conducted for this period has focused on pottery typology. It has been possible to establish diagnostic types for this period, even though the sample for this period is relatively small.





Figure 5: *Mucuras*, Muisca mummy, gold offerings: *Tunjos*, cacique regalia (top: left to right). Jar with high neck, olla *cuarzo abundante*, jars with globular bodies (bottom left to right) Museo del Oro Bogotá, Colombia.

During the Early Muisca Period, the *Mosquera* types disappear almost completely and there is an increase of jars with high necks and handles (Boada 1998: 65) (Figure 5), possibly for serving liquids especially *chicha*. There is also an increase of *Desgrasante Gris* and *Cuarzo Fino* (Boada 2006: 40). The ceramics of this period are characterized by sand-tempered ware (*Arenoso*) (Langebaek 1998: 169). The type *Funza Cuarzo Abundante* (sometimes placed in the late Herrera Period (Patiño 2003: 154) has high amounts of quartzite, is usually cream in color, and is sometimes slipped red or orange (Patiño 2003: 148; Broadbent 1971: 194). The forms for this type include bowls and *ollas* (Figure 5), indicating again cooking and serving functions (Broadbent 1971: 195; Langebaek 1998: 168). *Tunjuelo Cuarzo Fino* is commonly slipped red, orange, or dark red (almost purple); when unslipped is of gray yellow color, both in the form of bowls and large *ollas* (Broadbent 1971: 200-201; Patiño 2003: 154). *Tunjuelo Arenoso* is

generally represented in jars with globular bodies (Figure 5), bowls, and *ollas*; it is tempered with fine sand (therefore abundant with quartzite), and has a yellow exterior and orange red interior, sometimes slipped with the same clay as the paste or, alternatively, orange on both sides (Broadbent 1971: 205).

### The Late Muisca Period

The Late Muisca period lasted approximately 400 years from AD 1200 to AD 1600 (Henderson and Ostler 2005: 149; Langebaek 1995: 103). During this period, a more centralized political authority begins to take place and there is the formation of a regional settlement hierarchy (Henderson and Ostler 2005: 149). This period is also characterized by the introduction of raised field agriculture and the erection of stone monuments (Broadbent 1969; Salge 2007) (Figure 6). The majority of information that we have from this period comes from ethnohistoric sources, as the Late Muisca period is contemporary with the arrival of the Spanish conquistadors to the Bogotá Sabana and Boyaca. This is supplemented by information gathered from archaeological projects focusing on this period of occupation. There is an increase in population size, as archaeological sites dating to this period are far numerous and larger than during any other periods of occupation, a fact corroborated in the Spanish sources. Larger settlements facilitated the centralization political authority, allowing an easier control<sup>8</sup> over the population (Langebaek 1995: 105). Trade also became more productive and extensive during this period, as indicated by the presence of foreign exotic materials found throughout the domain of this chiefdom society (Langebaek 1987: 116). There is also an increase in the number of gold artifacts dating to this period that were used in offerings and as indicators of personal status

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<sup>8</sup> “Social control is taken to consist of all the nongenetically acquired processes by which individual and group behavior is directed along certain lines and diverted from others” (Fried 1967: 9).

(Figure 6). There is an increase in ceramic density during this period in the archaeological record, also reflective of an increase in the population. This increase was a direct result of agricultural productivity related to the introduction of the raised field system known as *camellones* (Boada 2006: 83).

The diagnostic ceramics representative of the Late Muisca period are the Guatavita sherd tempered ware (*Guatavita desgrasante tiestos*), Gray tempered ware (*Desgrasante gris*), and *Laminar duro* (Boada 2006: 58; Langebaek 1995: 169-178; Broadbent 1971: 196, 201, 205). Distinctive characteristics of a *Guatavita desgrasante tiestos* include: a tempered paste with the inclusion of particles of sherds that are redder than the paste, giving it a crystalized texture, a reddish yellow color (5YR 6/8) or gray color (5YR 5/1), and oxidized walls in most cases; rims are usually curved, but some are flat and inclined; red slipped decorations occurs on both the interior and exterior (Broadbent 1971: 197; Langebaek 1995: 171). The forms found for this ware include “footed cups, bowls, jars *ollas*, *mucuras*, and anthropomorphic vessels associated to storage, serving and ceremonial activities” (Langebaek 1995). *Desgrasante gris* is characterized by soft gray mineral paste and fine texture, usually oxidized into a red color and decorated with red and white paint over the paste (Broadbent 1971: 201). The color of the paste is reddish yellow (5YR 7/6); firing is usually complete with a gray core (7.5 YR 6/0) and a laminar texture; rims are generally rounded; and there are abundant particles in the temper (Langebaek 1995: 173). The forms of this type include *ollas*, jars, *mucuras*, and anthropomorphic vessels (Langebaek 1995: 173). The *funza laminar duro* is characterized by its compact texture; it is laminated and gray-slipped with red decorations present; it has a less oxidized nucleus than the previous wares and it is found in the forms of jars and *ollas* (Broadbent 1971: 206).

There is also an increase in the ceramic forms associated with ceremonial activities especially of ceremonial jars and decorated cups; these are decorated not only on the outside as in the Early Muisca period, but also in the inside of the vessels (Langebaek 1995: 117). It is curious that the majority of the imported wares were utilized in feasts and associated with serving liquids and foods in the case of jars and plates and that the cups were associated with ritual practices (Patiño 2003: 142). The increase usage of exotic ceramics was not exclusive to the elites as it was also available to the lower classes, as reported in surveys at various archaeological sites (Langebaek 1995: 107).



Figure 6: Phallic monument at the site El Infiernito, Colombia. Gold regalia. Golden cacique figurine wearing regalia (top left to right). Gold chest plate. Gold offering representing high status individuals. Muisca raft possibly used in El Dorado ritual (bottom left to right). Museo del Oro Bogotá, Colombia.

## Political Structure and Social Organization

The Muisca were a highly stratified society<sup>9</sup> consisting of many independent chiefdoms (Figure 2), separated from one another by geographic barriers (Kurella 1998: 194). They possessed a solid government with a complex social structure where the chief and nobles were at the top of the social pyramid and at its base the farmers and slaves (Perdomo 1977: 16). It is not currently known what percentage of the population belonged to each of the social classes an issue that needs to be addressed on future projects. The chiefdoms of Bacatá and Hunza (Bogotá and Tunja) were ruled by the Zipa and the Zaque respectively, titles given to the most powerful chiefs in the region (Broadbent 1981, 261) a status achieved “due to the submission of other chiefdoms through warfare” (Kurella 1998: 194). The defeated chiefs would be able to maintain some of their power but paid tribute to their conqueror (Aguado 1956, 1: 259). The chiefs of the larger independent territories of Sogamoso, Vélez and Duitama maintained absolute autonomy over their territories with the lower chiefs under their rule but were constantly competing to maintain control. There was a marked hierarchy between absolute and subservient chiefs but this was the most powerful position in Muisca society.

This ruling elite and their matrilineal kinship (Kurella 1998: 195) were at the top of society and had privileges denied to the lower classes. Shamans and priests were also part of this privileged group and had a high status and rank within the society (Labbé 1986: 154). The *xequés* or high priests were in charge of medicinal and religious rituals including feasts, burials and weddings enhancing their power in the society (Castellanos 1955: 158). The priest also maintained social stability and descent groups through myths and rituals (Fried 1975: 77). Given “the close tie between religious ritual and episodes of feasting, it is understandable that rank and

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<sup>9</sup> “A stratified society is one in which members of the same sex and equivalent age status do not have equal access to the basic resources that sustain life” (Fried 1967: 186).

religious status would be vested in the same individuals” (Fried 1967: 137). Priests were under the absolute rule of the chiefs and did not receive tribute from the population directly but from the chief to whom they owed alligence in order to maintain social order in the form of redistribution (Kurella 1998: 196). Professional soldiers occupied the next step in the social pyramid indication of the importance of warfare in political and social development between the chiefdoms. The ranked soldiers or *guachas* as they were known in Bacata “seem to have formed a special strata in Muisca society” (Labbé 1986: 154) and belonged to the chiefly class or the elite. They will gain prestige in battle by the number of war trophies and captives they were able to take and had access to certain privileges and if a chief had no decendants these soldiers could be placed as chiefs (Kurella 1998: 198).

The privileges enjoyed by the higuer classes included the consumption of deer meat, corn, wearing gold regalia, colored cotton blankets, and the practice of polygamy (*see* Boada 2006; Pradilla *et al* 2005; Cardenas-Arroyo 2002, Kurella 1998; Labbé 1986). These luxuries were only permitted for the elite and lower social classes required permission to have such priviliges (Visitas de Boyaca 1560: 75). The lower social classes consisted primarily of artisans and merchants; followed by farmers and finally slaves (Labbé 1986: 154, Kurella 1998: 198). Slavery possibly being the first type of social strata starting in the Herrera period or earlier<sup>10</sup>.

All the social classes payed tribute to the chief. The tribute in the form of labor, foods, minerals, and slaves was later redistributed to the chiefly class and partly to the lower classes (Salge 2007: 45). Redistribution of goods is the main economic integration process in ranked societies (Fried 1967: 117) and accounted for the only opportunity the lower classes had acces to restricted foods such as deer and corn. Different social classes had different acces to basic

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<sup>10</sup> “Slavery was one of the initial forms of stratification, perhaps the very first” (Fried 1967: 217).

resources including food which has important consequences on the development of social and political institutions (Fried 1967: 54). The marked social restrictions imposed in foods are associated with rank and status and were strictly enforced by the chiefly class to assert control over the population. The implementation of a restrictive diet is directly relevant to social stratification as “ranking is significantly dependent on the availability of food, and the origins of stratification refers to the development of differentiated rights of access to basic resources” (Fried 1967: 111, 191).

Archaeologists have been able to identify certain indicators to assign social status of Muisca individuals. There is a definite association between status and material goods, although archaeologically it is difficult to distinguish between the two (Chase *et al.* 2001: 107). For the Muisca status is generally determined by the type of burials varying in their location, type of offerings, and the quality and size of tombs (Figure 5 and 6), as well as the type of diet identified through stable isotope analysis (Cárdenas-Arroyo 2002) and mummification. These factors are usually correlated with descriptions found in the Spanish chronicles which facilitate the identification of status and rank of individuals and its repercussion in their diet.

## CHAPTER FOUR: MATERIALS, METHODS AND ANALYSIS STRATEGY

### Archaeology

The archaeological data used for this project was assessed and collected from: the archeology laboratories of the Universidad Pedagógica y Tecnológica de Colombia (UPTC) in Tunja (Figure 7); the laboratory at the Instituto Colombiano de Antropología e Historia, Bogotá (ICANH); and, the Ceramic and Stone tools Deposit at The Museo del Oro of the *Banco de la Republica*, Bogotá (Figure 8). During a preliminary research trip in June 2007, I visited these three laboratories and was given permission by Eduardo Forero and Victor Gonzales of the ICANH, Luz Alba Gomez of the Museo del Oro, and Helena Pradilla from the UPTC to examine archaeological material belonging to the Muisca culture related to dietary practices. I traveled to Colombia again from November 28, 2008 to January 31, 2009 to conduct the analysis and collection of data from Muisca artifacts and ecofacts located at these institutions

At UPTC I described, drew to scale, measured, and photographed ecofacts used as food recovered in the Muisca sites of Los Altos Santuarios and La Muela. I performed this analysis on faunal bone and plant material from the mentioned sites and brought some of that material back to the United States in order to conduct chemical analysis for a future project on stable isotopes (samples of deer bone). The material analyzed include osteological material belonging to multiple species of animals (deer, guinea pig, fox, birds, puma, possum) (Table 3) and plant remains from a variety of species recovered in excavations at these sites, including corncobs, corn seeds and bean seeds (Figure 7). Pradilla has already made a classification of the varieties of these corn and bean remains, which is of great importance for this research. There are 40 unidentified seeds from La Muela that were also observed, but the recognition of these species



should be conducted by a botanist or another specialized professional, possibly during a future project. I also collected information from unpublished reports from excavations at La Muela and Los Altos Santuarios located at the UPTC archaeology laboratory.

In the case of faunal bone I focused on recording information pertaining to deer bone *Odocoileus virginianus*, and *Mazama sp.* and Guinea pig bones *Cavia porcellus* also using the methods described above (Table 3). For deer, there are 2,557 fragments of bones belonging, to at least 28 individuals and 503 fragments for guinea pig, belonging to at least 47 individuals. Pradilla (*et. al* 2005) visually inspected and visually selected samples of these bones to determine if any type of evidence of human processing such as cut marks, burning, and bite marks were present and was able to identify multiple samples that showed these characteristics. I inspected faunal remains from other species found at these sites, but focused on deer and domesticated guinea pig, especially as these two mammals were the most important sources of animal protein for the Muisca according to the chronicles and the archaeological record.

Archaeological material from the Museo del Oro and the laboratories at the ICANH were also analyzed and evaluated. I drew to scale, photographed, identified, and described ceramic and stone tools artifacts utilized by the Muisca for the acquisition, preparation, storage and/or serving of foods in order to determine their specific function and purpose. I examined and described a variety of *ollas*, cups, plates, jars, salt vessels, and other forms of ceramics (Figure 8). The ceramics analyzed were visually and randomly selected from the inventory at the ceramic and stone tools deposit in the Museo del Oro, Bogotá, where one of each of the forms mentioned earlier was represented. The function of these ceramics was established as well as the identification of their typology through the identification of form, inclusions, and color. Manos and metates were examined and recorded in the same manner as the ceramics (Figure 8). Other

stone tools were also examined and recorded, including stone axes, sharpening stones, chert tools, flakes and cores, fishing net weights, mortars, containers, atlatls, and other artifact types (Figure 8). The same process of selection used for the ceramics was applied to the stone tools; where form, purpose, and size were taken into consideration. The stone tools were also described in terms of their color, function, and the material from which they are made of (Table 4). The analysis of these artifacts brings insight and perspective as how food products were processed by the Muisca, a crucial step for establishing an accurate dietary reconstruction for this culture.



Figure 7: Archaeology Laboratory at the UPTC, Tunja: Muisca craniums from La Muela, Ceramics from La Muela, Deer bone samples from La Muela (top left to right). Deer bone remains from La Muela, Guinea pig pelvises from La Muela, Archaeological site of La Muela, Tunja currently the UPTC (bottom left to right).



Figure 8: Ceramic and stone tools deposit at the Museo del Oro, Bogotá, Muisca stone tools, metate (top left to right); Muisca axe, atlatl, Muisca ceramics (bottom left to right).

### Ethnohistory

I searched for primary sources and modern publications of Spanish chronicles that mentioned aspects of the Muisca diet at various locations in Bogotá and Tunja. I visited the Archivo Nacional de Colombia in Bogotá, as well as the Archivo Histórico de Tunja, the Biblioteca Luis Angel Arango Bogotá: *Sección de Libros Raros y Manuscritos*, Academia Boyasence de Historia in Tunja, and the library at the UPTC in Tunja.

### Ethnobotany

For the ethnobotanical portion of the research, I visited the Sunday Markets of Bogotá known as Corabastos, Paloquemao and Codabas as well as the main produce markets in Tunja, Boyaca, Villa de Leyva, Boyaca and Neiva, Huila, where people from these cities and the surrounding regions come to sell and buy agricultural products (Figures 9, 10, 11). In these locations I searched for food products believed to have been found in the Muisca diet and that are still utilized today. I used the sources described above and my previous knowledge of these products (as I grew up in this region of the Andes and some of these foods were part of my diet). I also received assistance from plant ecologist Jennifer Navarra of the University of Central Florida (Figure 11) in order to aid me in the taxonomic identification of these plants. These products included roots such as: *arracacha*, which is one of the main ingredients of the *ajiaco* the traditional dish of Bogotá; *achira* used today to make the salted crackers that have become so popular that airlines in Colombia give them out instead of pretzels or peanuts; *ibias*; *cubios*; *chuguas*; varieties of potatoes; cereals, such as quinoa; and various species of legumes, squashes, and fruits (Table 1).

After the identification of these plants in the market I purchased them, measured them, weighted them, photographed them (next to a 1cm x 1cm scale), cooked them if required, tasted them, and described these products in detail (Appendix B, Tables 5 to 9). A number of samples were randomly selected for each of the products acquired, where the mean size measurements  $\pm$  standard error was calculated for each of the values (Tables 5 to 9). The price, by quantity of each of the products, was also recorded. The purchased products constituted in some cases different varieties of a single species and were catalogued and described individually. I dried and froze slide samples of all the species purchased and stored them at my family's apartment in

Bogotá until I am able to apply for permits to import them to the U.S. to perform chemical isotope analysis for a future project. I also purchased guinea pig meat that is still sold at these markets, from which I also collected slide samples that were then frozen. Guinea pig is still widely consumed in the departments of Huila, Cundinamarca, Boyaca, and Nariño, Colombia where the ancient chiefdoms of the Muisca and San Agustín developed. I also identified the modern uses of these foods and made interpretations of how these products were used by the Muisca, again using my previous knowledge of these foods, written sources, previous published and unpublished research, traditional recipes, and the local knowledge of the people selling, raising, or using these plant and animal species (Table 1).

I also conducted some participant observation with farmers, merchants, family members, and friends who are familiar with these products to gain an understanding of where these products are acquired, how they are utilized, and who eats them. For instance I was invited by a friend's middle class family to eat a traditional dish known as *Cocido Boyasence*. The interesting thing about this experience was that this dish - with a variety of Muisca root crops such as *ibias*, *cubios*, and *arracacha* - was not usually prepared or eaten by this family. As they knew I was investigating the uses of these products they asked their maid to prepare it for me as she regularly prepared it for her family. Obviously the maid belonged to lower social status and commonly ate this dish, suggesting a modern dietary stratification. Some of the family members did not even try the dish and, although the appearance of the dish was not very appetizing, its flavor was exceptional and some of the family members who had never tried it did and were impressed by its rich and fresh flavor. It was very interesting for me to see how, even through having access to these products, the higher social classes in Bogotá probably have never even heard of or tried some of these rich foods. In other instances I asked my aunt to make some other



traditional dishes and I helped in the cooking process and recorded the procedures for making them, such as the traditional dish *ajiaco*. When in the markets, I talked to the vendors and merchants that sold these products and asked them basic questions about their products, prices, and places of acquisition.



Figure 9: Paloquemao market, Bogotá (left). Codabas market, Bogotá (right).



Figure 10: Neiva market, Huila (left). Villa de Leyva market, Boyaca (right).



Figure 11: Plant ecologist Jennifer Navarra analyzing food products (left). Tunja market, Boyaca (right).

## CHAPTER FIVE: FINDINGS



Figure 12: Variety of Muisca Crops.

## Plants

The Muisca consumed a great variety of plants which they cultivated, gathered, or traded for their local products (Figure 12). As stated before, the diversity of these plants comes from the great variety of microclimates in this part of the Andes. The Muisca exploited resources through the production and acquisition of plants from high elevations, such as tubers, squashes, and fruits (especially varieties of blueberries and passion fruits), as well as mild elevations, where grains and beans were grown, and at low elevations with warmer climates for the production of cotton, coca, and tropical fruits. The different ecological zones described here were accessible to the Muisca within a few hours of walking distance, allowing these populations to access a great variety of foods in their diets a strategy known as microverticality (Kurella 1998: 199).

The Muisca cultivated the majority of their crops in elevated fields known as “*camellones*.” *Camellones* are artificially elevated surfaces that allow the roots of the crops to be drained and reduce humidity (Boada 2002: 83). This strategy permitted the farmers to prevent frostbite, and reduce the effects of droughts and floods minimizing crop failure. Some of the lands utilized in antiquity using this method continue to be utilized for agriculture in the present demonstrating these modified soils have improved qualities as demonstrated in other South American archaeological sites (Walker 2011: 10). Muisca agricultural economy is generally described as based on corn and beans (Kurella 1998: 198) and, although these products were essential for the Muisca, it was tubers that supplemented the diet of a large portion of the population. The majority of the corn harvest was destined for the production of *Chicha* and was controlled by the chiefly classes. In contrast, tubers were more accessible to the general population given that they were easily grown and can better resist different types of climates,



diseases, and elevations; they also provided difference in the flavor and consistency of the Muisca diet (Table 1, Table 5, Appendix B).

## Tubers and Roots

### *Canna edulis*: Achira or Canna

*Achira* can be grown in tropical zones as well as temperate and cold zones. This plant was one of the first to have been domesticated in the Andes; “cooked tubers appear in dry coastal tombs dating to 2500 BC, indicating both an ancient origin and the fact that the roots were esteemed highly to be carried all the way from the highlands (ACTIBS 1989: 28). It comes as no surprise that the Muisca were one of the many societies in the Andes to utilize this tuber, given its early domestication and distribution; it was called *Chisgua* or *Rijua* in Chibcha the language of the Muisca (Patiño 1990: 68). The domestication of *achira* most likely developed during the Herrera period but archaeological evidence for it only exists for the early Muisca period. The rhizomes of the canna are large and off-white in color or white and purple when peeled depending on the variety; there are the part of the plant that is most valuable for consumption (Figure 13, Table 1). The origin of this plant is unknown, but it is believed to have originated in South America between Colombia and Peru and was commonly utilized for food in Tunja during the 10<sup>th</sup> century A.C. (Parra 2001: 241).



Figure 13: *Achira* Rhizomes.

Conclusive evidence for the consumption of this tuber by the Muisca comes from the existence of *Canna edulis* phytoliths in the human dental calculus samples from Soacha and Tunja taken by Parra (1998). Dental samples from 33 adult individuals from these two Muisca populations were analyzed, resulting in the identification of chains of round bodies with protuberances and depressions that are characteristic of *Canna edulis* phytoliths (individual Tunja 4) (Parra 1998: 21). Langebaek (1994: 4) also recognized the presence of *Canna* in the areas inhabited by the Muisca, but does not mention its consumption. Rozo states that: “*Achira* was consumed by the Muisca but that this fact is not mentioned in the Spanish chronicles or primary sources because tubers were generally described as *turmas* and grouped as a single category and not differentiated according to their species” (1998: 23).

It is clear that the Muisca consumed *achira*, but further archaeological and anthropological studies are necessary to understand the possible uses of this species by the society (Bravo *et al.* 2005). Starch identification of plants from archaeological materials is currently unavailable in Colombia, but perhaps this type of study could have important significance in our understanding of the utilization of this crop. “*Achira* starch granules are by

far the largest ever measured - twice the size of potatoes starch granules, the previous record holder” (ACTIBS 1989: 30), suggesting promising results if starch identification of Muisca archaeological remains were analyzed using this technique. There are no indications that the consumption of this tuber was restricted to specific social classes in Muisca chiefdoms and it appears that it was accessible to the majority of the population (Parra 1998: 22). It is not clear how the Muisca consumed or prepared this tuber, but it is possible that the methods utilized in modern times resemble how the Muisca prepared and ate the *achira*.

These tubers are generally not eaten directly, but rather are utilized to make a fine, easily digestible powdered starch (Britnall and Conner 2001: 184). In Colombia this starch is used to make fine salted crackers with cheese that have become increasingly popular in the country, although the tuber can also be eaten raw. The department of Huila in the southern Colombian Andes is the region where these *bizcochos de achira*, as they are known, are most popular, but the entire country has become familiarized with this product, to the point that they have replaced peanuts or pretzels on Avianca the largest airline in the country. The majority of the production in Colombia of *achira* comes from Boyaca where the rhizomes are directly cooked and eaten, especially in the provinces of Marquez (Bravo *et al.* 2005).

I tried to purchase the rhizomes when I visited the markets described previously, but was only able to purchase the powdered starch and was told that this was the form this product was usually sold to consumers; I paid around 1 US for 2 lbs. (Figure 14). I also visited the provinces of Altamira, Fortalecillas, and Algeciras, Huila; the people in this region say they sell the best *bizcochos de achira* in the country. Generally the production of these treats takes place in local houses in the area where people make large cement or stone ovens to bake the crackers; they then sell them in the front of their doors (Figure 14) or walk around selling long plastic bags

filled with the *bizcochos* in a variety of sizes. One hundred units sell for approximately 2 USD. In addition to the small businesses that produce these crackers, two large manufacturers also produce them for mass consumption. The largest, Ramo S.A., one of the most important bakeries in the country, produces small bags containing 30g. of *achiras*. Achiras del Huila, which specializes in these crackers, sells them in a variety of packages and quantities; a 25g pack is sold for approximately .75 USD (Figure 14). According to these two industries, the *bizcochos* contain *achira* starch, fresh curd, eggs, margarine, and salt. *Achira* is high in protein (5g), (18.2mg) iron, and (21.3mg) calcium with 125 calories in a 25g bag, according to these manufacturers (Appendix B).

Today *achira* is grown in a number of places, including Peru, Ecuador, Venezuela, Australia, St. Kitts, Indonesia, Taiwan, Philippines, Madagascar, Sri Lanka, and Burma. Easily digested, it's commonly given to the elderly, children, and people with digestive problems. In antiquity the seeds of the *achira* were used as resonators for musical instruments (Patiño 1990: 58). The starch is not only used for food but also for sizing and laundry starch. The leaves and young shoots can also be eaten or used to wrap foods for transportation, and the plants are also grown for ornamental purposes (Britnall and Conner 2001: 181). The popularity of this crop in Colombia and other regions, and its potential for a variety of uses, shows that *achira* has a promising future in the growing global economy.



Figure 14: Merchant in the produce market in Neiva, Huila selling *achira* starch and achiote (top left). Selling *bizcochos de achira* in front of the house in Fortalecillas, Huila (top middle, top right). Making *achiras* in the patio Altamira, Huila (bottom left). Oven to bake *achiras* Altamira, Huila (bottom middle). *Achiras del Huila* package (bottom right).

### Arracacia xanthorrhiza: Arracacha

It is possible that this tuber was the first domesticated plant in the temperate zones in the Andes and it is even suggested that it is actually the first to have been domesticated in South America (Domínguez 1981: 88), but there are no dates to support these claims. The place of origin of this crop is believed to be in Colombia, where you can find all the known varieties of this crop (Cardenas 1969: 66; Langebaek 1987: 64; Sauer 1950: 488). However, this is difficult to confirm because all the wild varieties of this tuber are extinct. It must have been cultivated by pre-Columbian societies in Colombia for thousands of years, given that it's not found in its wild state anywhere (Bravo *et al.* 2005). *Arracacha* was extensively cultivated by the Muisca (Boada 2006: 133). This society most likely domesticated this tuber before corn or potato and it was clearly utilized by the Muisca given its presence in the Colombian central cordillera (Sauer 1950: 487; Cárdenas 1969: 45). "There is no doubt that *arracacha* was cultivated in the central cordillera in Colombia so far North to the region inhabited by the Paeces and the Yalcone" (Patiño 1990: 16). According to Sauer, the early domestication of *arracacha* in Colombia makes this region ideal to be considered one of the centers of origin for domesticated plants in the world (Sauer 1950: 487; Domínguez 1981: 83).

*Arracacha* is also mentioned in some early Spanish chronicles. Fray Pedro Aguado, who lived in Cundinamarca, used the term *apio* to refer to *arracacha*; this word means "celery" in Spanish (1916: 590). *Arracacha* is in the same family (Apiaceae) as celery and the stems of both plants are very similar indeed. Fray Pedro Simón describes that *arracacha* was cultivated extensively by the Muisca (1981 [1625] II: 271). Zamora describes crops of *arracacha* in Colombia (then the Nuevo Reyno de Granada) as continuous and abundant (1980 [1701]: 42). "Nonetheless it was so overlooked in colonial times that it wasn't given a scientific name until

300 years after the Spanish conquest” (ACTIBS 1989: 47). There was no evidence in the chronicles, archaeology, or in modern practices of social restrictions regarding the consumption of *arracacha*. The entire social group eats this tuber and given its early domestication and wide distribution, this was probably also the case for the Muisca. Only the Muiscas in Boyaca are stated to have grown this crop, although it was more widely distributed and important in Colombia, especially given that it is a main ingredient in the *ajiaco* (Figure 14) and the *puchero andino* traditional dishes in the area of study (Langebaek 1987: 64). “Indeed, most soups in Colombia contain *arracacha*” (ACTIBS 1989:49), demonstrating the importance of this crop in the country.

*Arracacha* is ideally grown at elevations exceeding 1800 meters above sea level. As mentioned earlier, *arracacha* plants resemble celery but with larger leaves; it produces yellow or purple flowers and grows to around 60 cm in height (Bravo *et al.* 2005). *Arracacha* is usually harvested before completing its seed cycle (ACTIBS 1989: 54). The roots of the *arracacha*, which is the part of the plant that is eaten resemble carrots, but are yellow or white in color and are also known as white carrots; these tubers contain high amounts of calcium and vitamin A. If cut, the roots of the *arracacha* can be yellow or white with cross rings of a purple color (Figure 15). The flavor of the cooked roots is similar to cooked carrots – earthy, very gentle to the palate, and with a strong pleasant sweet smell with a hint of wet soil. I encountered two varieties in the markets of Villa de Leyva, Tunja, and Bogotá: a large yellow variety and a pigmy variety, both costing approximately .25 USD per lb. (Figure 15, Table 5, Appendix B). As mentioned earlier *arracacha* in Colombia is usually used in the preparation of soups but it can also be grilled, baked, boiled, or fried. Acosta and Moreno (1997: 16) indicate that in Colombia during the 1990’s, 7.876 hectares of *arracacha* were cultivated annually, producing approximately 60,000

tons each year; 37.5% of this yield is destined for local consumption (1/3 of arracacha production in Cundinamarca and Boyaca is sold there).

*Arracacha* can become an important crop in other regions outside the Andes, especially given its exotic flavor, facility to be cultivated, and the different ways that can it be prepared. Brazil and Puerto Rico have been growing *arracacha* since the 1910's and it has turned into a staple food for some populations in these countries (ACTIBS 1989: 53). The ancient uses of this crop and its early domestication made this tuber of extreme importance in the Muisca diet. Further research on the origin and domestication of *arracacha* should increase our understanding of how populations in the Andes developed agriculture in this region and evolved into the complex societies that the Spanish encountered during the conquest of South America.



Figure 15: Large yellow *arracacha* variety (top). Pygmy *arracacha* variety. *Ajiaco* traditional soup of Cundinamarca with *arracacha*, two potato varieties, corn, avocado, *guascas*, cilantro, and chicken (bottom left to right).



### Tropaeolum tuberosum: Cubios or Navos

This tuber grows in high elevations that exceed 3000 meters above sea level, making it ideal for populations inhabiting the high Andes. Although Domínguez (1981: 90) suggests that Cubios are native to Colombia and that its domestication began there, the ancestral plant is unknown. A weedy type that grows in elevations around 3000m in Peru and Ecuador could be a wild variety of this plant and indicate its origin (ACTIBS 1989: 73). Nevertheless, the origins of this plant are in the central Andes and it is cultivated from Colombia to Bolivia (Bravo *et al.* 2005). Cardenas-Arroyo(2002: 20) explains that: “to understand early agriculture in Colombia it is not only feasible to assume that the domestication of corn and yuca define and explain the agricultural processes there, but that it is also necessary to evaluate the importance of the *Cubios*, *Chuguas* and *Ibias* which influenced dramatically the agricultural developments in the central Andes.” *Cubios* were recognized as a Muisca product in some of the earliest anthropological descriptions of this society (Reichel-Dolmatoff 1965: 159), and the predecessors of the Muisca in Cundinamarca and Boyaca cultivated this tuber during earlier occupations (Boada 2006: 133).

Early Spanish sources also make reference of this crop in Muisca territory. Simón (1981 [1625] III: 401). described the Muisca as great farmers of corn, yuca, sweet potato, *arracacha*, *cubios*, *turmas* (potato) and other roots.

*“Otras que se llaman cubias, que echan en sus guisados y les es de gran mantenimiento y son quasi a manera de rabanos en sabor y en todo estando crudos y este es el verdadero mantenimiento de que sirven por pan”* (Jiménez de Quesada 1962 [1545]).

This conquistador while describing the roots cultivated by the Muisca explains that some of them, called *Cubias*, are used in stews that give great nutrition and resemble radishes, when raw and are served as a replacement for bread. This tuber was essential to the Muisca as it could

nourish populations located at high altitudes. In the Andes this root is associated with poverty and it is avoided by the higher social classes because of its indigenous origin and eaten only by the lower social class (ACTIBS 1989: 69). In the case of the Muisca, it is not clear that *cubios* were avoided in a preferential diet by the elites, but because of the high elevations where the *cubios* thrive, it is possible that only populations living in high altitudes consumed them and, high elevations are commonly relegated to the indigenous lower social classes in the Andes. It seems that this crop was of minimum importance to the Muisca. Only the populations of Choconta, who had access to lands near the *paramos* are known to have cultivated this crop; the Muisca elite probably avoided it in order to eat foods similar to their counterparts at lower elevations (Langebaek 1987: 61).

Today in Colombia *cubios* are commonly utilized in the preparation of soups and stews, such as the traditional dishes known as *Cocido Boyasence* (Figure 16) and *Mazamorra Chiquita* (Table 1). The first is a stew containing a variety of tubers, including potato, *cubios*, *ibias*, *chuguas*, sausage, pork, beef, legumes, and spices. It is known that “the stew” was not a Muisca form of cooking, but it was assimilated from the Spanish during the conquest (Diaz *et al.* 2008: 42). The second is a soup made with different meats (pork, chicken, beef), beans, corn, *cubios*, *chuguas*, *ibias*, carrots and potato (for descriptive recipes of these two traditional dishes see Diaz *et al.* 2008). *Cubios* are high in Vitamin C, high in protein, and were considered to be an anti-aphrodisiac; they were given to Inca soldiers and women to reduce their desire for intercourse during wars (Cobo 1965 [1639]). “Male rats fed a tuber diet showed no decline in fertility, but did show a 45% drop in total levels of testosterone” (ACTIBS 1989: 70). This plant is grown for its flowers in Britain and the U.S., demonstrating that it can be grown outside its native Andes.

Given its adaptability to high elevations, it could be beneficial to introduce this crop to human populations living in high altitudes such as the Himalayas.

I was able to purchase two varieties of *cubios* in Colombia, a white and a yellow variety (Figure 16, Appendix B, Table 5), but there are more than 100 varieties in the different countries where it is grown in an array of colors and sizes (ACTIBS 1989: 73). The cost of this product in the market of Paloquemao in Bogotá is approximately 1,000 Colombian pesos, or .50 USD, per lb. making it very accessible for people who can't afford more expensive products. The flavor of the tuber, as explained by Jiménez de Quesada, is very similar to radishes and this could be the reason it is not that popular within certain groups of people and considered to be a food for the lower strata.



Figure 16: Yellow Villa de Leyva, Colombia and white *Cubios* Bogotá, Colombia. White *Cubios*. *Cocido Boyasence* with *cubios*, *ibias*, *chuguas*, corn, chicken, potato, pork, and sausage traditional dish of Boyaca (left to right).

### Oxalis tuberosa: Ibias

Similar to *cubios*, *ibias* are a main ingredient in the preparation of the *cocido boyasence* (Figure 16) and *mazamorra chiquita*. The majority of the sources that describe *Cubios* as a Muisca crop also mention the utilization of *ibias* by this complex society (Reichel-Dolmatoff 1965: 159; Cardenas-Arroyo 2002: 20; Boada 2006: 133; Roza 1998: 23). Although this root is not native to Colombia, it was used by pre-Columbian societies in Cundinamarca and Boyaca after being introduced from its place of origin in Peru, where the majority of varieties are found (Domínguez 1981: 90). This tuber (Table 1) is believed to be one of the oldest Andean crops and has been found in early coastal archaeological sites far from their native high lands (ACTIBS 1989: 90). The earliest dates of cultivated *ibias* in the Muisca territory comes from the site of Aguazuque, Cundinamarca dating to *cal* 2345 BC – 2240 BC, showing how early this crop was adopted in the region. Its ecological range is found between 2800-4000 meters above sea level, making this tuber ideal for the consumption by populations living in high elevations, especially given its qualities to resist frostbite. This tuber has been domesticated, but there are wild varieties which are grouped as a single species with the domesticated forms (Bravo *et al.* 2005). There are around 50 different varieties, 12 of them domesticated (ACTIBS 1989: 90), in an array of colors that range from white to black, to yellow, to pink, to red (Bravo *et al.* 2005). In Colombia the most common varieties are the pink and the red ones. The pink *ibia* was the variety I was able to acquire for this project for around 2,000 Colombian pesos or 1 USD per lb. (Figure 17, Appendix B and Table 5).

Fray Alonzo Zamora (1980 [1701]: 43), noted that *ibias* were cultivated in the Nuevo Reino de Granada, a fact that is repeated by Oviedo (1930: 46) 150 years later. These tubers were commonly consumed in Bogota during the XIX century (Holton 1857: 150) and are also eaten

today demonstrating the continuity of the traditional foods in this region. As with many of these productive tubers, *ibias* are also shunned by the higher social classes today in the Andes (ACTIBS 1989: 84), a stigma that is possibly a continuation of ancient practices. Chiefly classes preferred the consumption of corn and left these tubers to the lower classes inhabiting higher elevations (Rozo 1998: 18). With better marketing techniques the nutritional and environmental qualities of this crop, such as its resistance to freezes, its high protein value, and its balanced content of amino-acids (which exceed those of the potato [ACTIBS 1989: 85]) can make *ibias* an important food not only in Colombia but in developing and industrialized countries around the world.



Figure 17: *Ibias* of the pink variety from Cundinamarca Bogotá, Colombia.

#### Ullucus tuberosum: Chuguas, Rubas or Ulluco

Another one of these high elevation tubers, the *ulluco* (Figure 18, Table 1), is also utilized in traditional dishes in Colombia associated with *cubios* and *ibias*. Reichel-Dolmatoff (1965: 140) mentions its utilization by the Muisca along *cubios* and *ibias*. Also introduced from Peru into Muisca territory, this tuber was adopted relatively early by the inhabitants of this region (Domínguez 1981: 89). *Ulluco* only exists in domesticated varieties and has been recovered from 4200 year old ruins in Peru, giving clues to its early domestication (ACTIBS

1989: 113). This root crop is considered one of the principal foods of the Muisca (Langebaek 1987: 59, Boada 2006: 133). As mentioned earlier, Cardenas-Arroyo (2002: 20) believes that our understanding of the domestication of *ullucos*, along with the *ibias* and *cubios*, through archaeological research can demonstrate how agriculture developed in this region, given that these products were fundamental in the diet of the Muisca. There are no descriptions of *ulluco* in colonial documents in relation to the Muisca, but its presence in the region, as well as its modern consumption by indigenous populations in Colombia, and its association with *ibias* and *cubios* demonstrates that it was utilized by societies in Cundinamarca and Boyaca prior to the arrival of the Spanish (Rozo 1998: 23). Perhaps their resemblances to potatoes although smaller and more colorful led the Spanish to associate this tuber with potatoes and to be described as *turmas* in the chronicles.

The roots of the *ulluco* are brightly colored and come in a wide variety of tones, ranging from yellow, to pink, to red purple, to brown, to black, to orange (Figure 19). They vary in shape dramatically, from round potato - like, to oval, to elongated, to curved even in tubers of the same plant (Figure 20). I was able to acquire three varieties in Colombian markets: a yellow variety in Villa de Leyva; a pink/purple variety in Bogotá; and, a brown/black variety in the market at Tunja. The cost was beets 4,000 Colombian pesos or 2 USD (Figure 19, Appendix B, Table 5). The taste of the raw and cooked *ullucos* resemble very much that of beets; the texture can facilitate the adoption of this food in places where beets are eaten. In Colombia *ullucos* are commonly used in soups and stews, as is the case for *ibias* and *cubios*, and are also associated with lower classes, including indigenous groups in the country. *Cubios*, *ullucos*, and *ibias* were avoided by the chiefly Muisca class and relegated to the consumption of lower classes. *Cubios* and *ullucos* can be grown at sea level, as in Canada and England, as well as in mid to high

elevations; it is also resistant to frost, and to drought, and also has a tolerance for marginal soils (ACTIBS 1989: 113), meaning that this crop could be produced in a great variety of environments.



Figure 18: Chuguas brown variety purchased in Bogotá, Colombia.

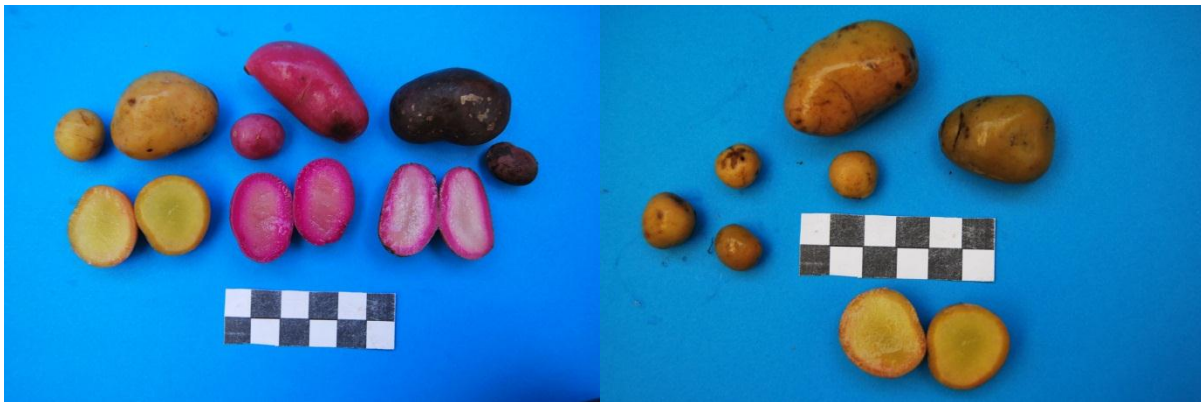


Figure 19: Yellow, pink and brown varieties of chuguas Villa de Leyva, Colombia.



Figure 20: Pink variety of chuguas different shapes and sizes Bogotá, Colombia.

### Polymnia edulis: Jicama

This plant grows wild in Colombia in mild altitudes and could have originated there (Table 1). In Peru as it is found in pre-Incan tombs, showing a wide dispersal (ACTIBS 1989: 122). Jicama can be eaten raw and this is way that is usually eaten in Colombia - with a bit of salt, as it was probably done by the Muisca. It contains a low amount of calories and can be processed into an industrial sweetener, which can be distributed commercially. It grows in elevations below 3000 m; it contains inulin a sucrose - free product that can be used by diabetics, thus giving this root a head - start to be marketed for this purpose (ACTIBS 1989: 117). Fray Pedro Simón (1981 [1625] II: 271) noted that “jiquima” was cultivated and eaten by the Muisca; it was also produced in Muzo near the emerald mines exploited by the Muzos, neighbors of the Muisca, with whom they extensively traded for emeralds with salt and other products (Vazquez de Espinosa 1948: 309). It was not possible to obtain jicama in any of the markets visited during the research trip to Colombia, given that jicama is off - season during the summer months (as mentioned by some of the merchants and farmers consulted). It appears that the consumption of this root is being replaced by processed sweets and tropical fruits; it is not easily found as it was, which could mean that the use of this root in Colombia is slowly disappearing.

### Solanum tuberosum, Solanum colombianum or phureja, Solanum andigena, Solanum rybinii and Solanum boyasence: Potatoes

Early archaeological descriptions of the Muisca explain that this society domesticated at least two varieties of potatoes (Reichel-Dolmatoff 1965: 159). It has been suggested that the potato was of lesser importance than corn and beans in the diet of the Muisca (Kurella 1998:



198). This statement is far from the truth because potato was essential to the Muisca diet and as important as corn and beans (Boada 2006: 133). Corn was mainly used for the production of *chicha* and controlled by the chiefly classes. The main staple food for the majority of the population was tubers, especially the potato. Langebaek (1987: 59) explains that, according to the majority of the Spanish chronicles, the potato was indeed one of the most essential foods for this complex society. Pollen analysis conducted in the Sabana de Bogota indicates that potato was grown in the raised fields utilized by the Muisca (Boada 2006: 133). The domestication of potato in this region is early, dating to at least the Herrera period. Although the most known forms of potato come from Peru, some species and varieties are native to Cundinamarca and Boyaca, Colombia, such as *Solanum rybinii*, *S. andigenum*, and *S. boyasense* (Domínguez 1981: 89). Labbé (1986: 154) states that the Muisca had only two varieties of potato, but it is more likely that it was at least three as suggested by Domínguez. In comparison to corn, the potato has high yields at high elevations that exceed 3000m and it is certain that it was the staple food of the lower classes (Domínguez 1981: 89, Salge 2007: 38).

Rozo (1998: 21-22) makes an excellent description of the use and varieties of potato by the Muisca. The Spanish did not call potato *papas* as it is currently known but rather referred to them as *turmas*. In the Chibcha language potatoes were known as *yomas* (Table 1) in general, but different varieties, sizes, colors and shapes had specific names. Yellow potatoes, possibly referring to *S. phureja*, were called *tybaiomy*, wide potatoes *gazaomy*, long potatoes *quyomy*, large potatoes *pquasiomy*, dark potatoes *funzaomy*, and white potatoes *xieiomy*. The extensive terminology demonstrates the wide variety of potatoes that existed in the region as well as their importance in the Muisca diet. Jiménez de Quesada (1962 [1545]: 9) in his expedition into Muisca territory described the presence of potatoes in large quantities and that the Muisca seem

to eat only this type of food. Simón (1981 [1625] III: 401) also mentions that the Muisca cultivated large quantities of potatoes.

Today, the potato continues to be of extreme importance in the diet of contemporary Colombians. Potatoes are cooked in an impressive number of styles, as was the case in antiquity (Rozo 1998: 21). In Colombia approximately 160,000 hectares are cultivated each year with potato mainly in Cundinamarca and Boyaca, with a production of 2420.696 tons per year and consumption by a single person of around 123 kg a year (Acosta and Moreno 1997: 32). I purchased 4 different species of potatoes at the markets mentioned in the methodology section: *S. tuberosum* sabanera at 1 USD per lb., *S. colombianum* or *phureja* at Criolla 1.5 USD per lb., *S. andigena* at 1 USD per lb., and *S. rybinii* at 1 USD per lb. (Figure 21, Appendix B, Table 5).



Figure 21: *S. phureja* criolla (left), *S. tuberosum* sabanera (center), *S. rybinii* rucki (right) Bogotá, Colombia.

### Manihot esculenta: Yuca

It is stated in the Spanish chronicles that the Muisca cultivated the yuca, a very important root crop in most of S. America (Simón 1981 [1625] III: 401). Archaeological evidence for the yuca in Colombia is found in the town of Malambo, Magdalena dating to 1120 years B.C. (Domínguez 1981: 84). The evidence comes from *budares*, which are artifacts used to process yuca but, there is no archaeological evidence from plant remains and date no archaeological evidence for the presence of this crop has been recovered in Colombia (Cardenas-Arroyo 2002: 19). Yuca (Figure 22) originated in the Amazon basin, but the closest botanical archaeological evidence to Colombia comes from Venezuela at a relatively late date 400-1500 AC (Pearsall 1992: 189). Oviedo (1930 II: 389) indicates that the Muisca cultivated the “good” kind of yuca, referring to some poisonous varieties, noting that the tubers could be in the ground for up to two years after they were ready to be used. The long preservation of this crop made it ideal for the Muisca. Yuca grows in temperate zones lasted twice as long as the yuca cultivated at lower elevations.



Figure 22: Yuca roots at the Paloquemao produce market at Bogotá, Colombia.

As is the case for potato, yuca continues to be a very important crop in Colombia. Acosta and Moreno (1997: 19-22) calculated that 200,000 hectares of land are cultivated each year at a national scale, producing 2000000 tons of yuca per year; production has dramatically increased

because of governmental stimulus through Finagro. The consumption of yuca is of great importance in the diet of rural and small populations and 70 % of the production of yuca is destined to personal consumption. Estimated consumption of yuca is 20kg per person a year. (Appendix B, Table 1).

#### Ipomoea batatas: Sweet Potatoes

Archaeobotanical evidence of the presence of sweet potatoes from Zipacón, Cundinamarca dated to 3270 +/- 30 BP and is the earliest evidence for this tuber in the Bogotá Sabana (Correal and Pinto 1983: 180-181). It was during the Herrera period that many of the roots and tubers in the region began to be domesticated or adopted. Sweet potato was possibly introduced to Cundinamarca and Boyaca from the Northern coastal regions, as it originated in dry areas and expanded from there to the rain forest and sabanas (Domínguez 1981: 84; Labbé 1986: 154). The diffusion of sweet potato into other areas from its place of origin is a very interesting process. It was cultivated in multiple regions in South America and as far away as Malaysia and Polynesia by native peoples. Sweet potato is native to the Andes, where there is fossil evidence for it dating to 11,000 year ago. Its presence in the Pacific islands is still debated (Brintnall and Conner 2001: 186). That it occurs in Pacific islands supports the hypothesis that people crossed the Pacific from South America to the Old World before the arrival of the Spanish; however, until further evidence is obtained this cannot be determined. It is also unknown how and from where the sweet potatoes reached the central cordillera in Colombia, but as mentioned earlier this root was being cultivated in this region at a very early date.

Sweet potatoes (Table 1) were regularly grown by the Muisca in at least 20 different municipalities during the conquest (Langebaek 1987: 61). The chronicler Simón (1981 [1625])

II: 271) mentions that at the arrival of Jiménez de Quesada to Bacata, the Muisca were cultivating this root in the adjacent regions. After the arrival of the Spanish in Colombia, the sweet potato began to be prepared as a “sweet”, a practice unknown by the Muisca where these roots were mainly roasted, baked, and used in soups (Patiño 1990: 6). Today in Colombia sweet potatoes are usually prepared as a dessert and the native forms of preparation have been completely replaced. Sweet potato continues to be produced in Colombia, but is not as popular as some of the previous tubers and roots described earlier. The introduction of cooking methods, such those practiced in the United States where this crop is commonly utilized can make it more appealing to Colombians in order to obtain the nutritional qualities that this root can offer. These roots contain relatively high amounts of protein for a starch (2% by weight), sugar, and beta-carotene (as high as that of carrots). Two varieties are grown in Colombia, a sweet variety (Figure 23) that is oddly – shaped and light brown in color and a salty variety (Figure 24) that is radish - shaped with dark brown exterior (Appendix B, Table 5).



Figure 23: Sweet potato of the sweet variety Bogotá, Colombia.



Figure 24: Sweet potato of the salty variety Bogotá, Colombia.

### Methods for the Preparation of Roots and Tubers

The verbs that refer to the act of eating in the language of the Muisca vary depending on what is being eaten. For eating roots the term is *Bgysqua* (Viricoechea 1834). Having a specific verb for eating roots emphasizes that these types of foods were of extreme importance for this society. Regarding the ways these foods were utilized, it is known that the Muisca ate some of these raw such as the jicama and the ibias (Rozo 1998: 48). The roots and tubers were also boiled, grilled, or used in stews after the advent of the Spanish. The roots were also cut in large pieces and used in soups, a method that is generally utilized today in the preparation of soups in Colombia, as in the renowned *sancocho* (Rozo 1998: 47). Grilling the yuca, sweet potato, potato and other roots not directly in the hot coal but in the ashes is also a practice that continues today, as was done during the Muisca period. Cooking methods utilized by the Muisca are also found in the Spanish chronicles. In the descriptions of the conquistador of Bogotá Gonzalo Jiménez de Quesada (1962 [1545]: 9) it is explained that *cubios* were used in their stews. Oviedo de Valdez (1852: 389) states that “their subsistence was corn, yuca of the kind that does not kill, and what they eat the most is potatoes and roots that they cook together and that these were the most

ordinary kinds of food,” suggesting again that eating these is for people with a lower social status.

## Grains/Cereals

### Zea Mays: Corn

The earliest evidence of corn domestication in Muisca territory is found at the sites of Zipaquirá, dating to 150 B.C., in the form of pollen samples identified in the area (Cardale 1981:49) and at the site of Tequendama, where the presence of ceramics, manos and metates dating to 275 +/- 34 B.C. (Boada 2006:27) demonstrate the use of corn by the early inhabitants of this region. In the site of Filomena pollen analysis demonstrates the existence of corn at this site dating to 2450 +/- 40 BC-500 AC (Boada 2006:49). The Muisca utilized a wide array of varieties of this grain (Table 1). In excavations at the site of La Muela in Tunja a total of 193 samples of corncobs (Figure 25) were recovered that were later analyzed in order to identify the varieties present (Pradilla *et al.* 2005). Through this analysis, it was possible to identify the following corn varieties: *Pollo*, *Pira*, *Sabanero*, *Cabuyo*, and *Tunebo*; the *Pollo* variety predominated (Madero 1990). The *Pollo* and *Cabuyo* varieties were also identified in Calima sites, where the earliest corn archaeological samples in the country have been recovered, demonstrating an early production of these varieties in Colombia (Bray et al. 1987: 447). At La Muela it was also possible to recover a sample of 275 cooked corn grains; the varieties mentioned earlier were also identified (Pradilla *et al.* 2005). The great variety of grammatical terms in Chibcha used for this crop suggests that a wide spectrum of corn varieties was available (Langebaek 1987: 59). Corn was considered the most important crop of the Muisca for its

religious and political significance as well as for its nutritional value and versatility (Kurella 1998: 198).



Figure 25: Burned corncob from excavations in the Muisca site of La Muela by the UPTC.

The cultivation of corn by the Muisca took place in raised fields known as *camellones*, artificially created in swamps (*humedales*) and high enough to prevent the roots from becoming humid, and also guarding against droughts and frosts (Boada 2006: 83). The use of *camellones* created favorable conditions for corn cultivation and, through the use of this agricultural method, the Muisca were able to produce two corn harvests per year, increasing the productivity of the land (Kurella 1998: 198) more specifically, the production of the *Pollo* variety that is very common today in this region and that can produce two crops a year (Boada 2006: 136). According to the Spanish chronicles, in January during the dry season, the fields began to be prepared and were planted during March at the beginning of the rainy season, and harvested during December (Simón 1981 [1625] III: 402). This traditional practice is still used today by the modern population. It is possible that the Muisca practiced a multicrop agricultural technique where different crops or varieties of a crop were produced at the same time side – by – side in the



*camellones*; for instance, in the same field corn, beans and squash were grown. Pollen evidence for multiple crops in a single field has been recovered in Muisca sites (Boada 2006: 141). The vague descriptions in the chronicles on the raised field system only mention corn as the product grown in the *camellones* (Boada 2006: 144).

One of the most important qualities of corn is that it can be stored for long periods of time. This was of great advantage for the Muisca. They were able to satisfy their nutritional requirements during times of famine and keep large quantities of this cereal stored for future feasts and the production of *chicha*, thus maintaining a certain control over the population. It is also clear that corn was extensively produced by this chiefdom; Simón (1981 [1625] III: 268) notices “that this region was as rich in maize as Neiva was rich in gold.” The production of corn for the Muisca is clearly demonstrated when one considers that it was the only crop that was declared to be produced by all of the Muisca chiefdoms, villages, capitancies, and *repartimientos* in the territories of Cundinamarca and Boyaca and in larger amounts than any other crop (Langebaek 1987: 60).

The general consumption of corn by the Muisca is also demonstrated by the presence of phytoliths of *Zea mays* in human dental calculus recovered in Tunja and Soacha; there the majority of the samples tested from individuals in different social classes showed the presence of this cereal in their diet (Parra 1998: 21). Although corn was consumed by all the Muisca social classes, this cereal was primarily consumed by the chiefly class and rarely consumed by the lower classes. The chiefly class controlled the production and storage of this cereal, which was mainly destined for their consumption and the preparation of *chicha* for feasts when it was also accessible for the lower classes (Kurella 1998: 199). This statement is also supported by stable isotope analysis of human bone recovered in the site of Las Delicias, Cundinamarca where

individuals considered to be of the chiefly class had the highest percentages for the consumption of animal protein and corn. Expecting mothers and young children of various social classes also showed a high consumption of animal protein and corn (Cárdenas-Arroyo 1993: 139). The stable isotope analysis of Muisca mummies, a funerary practice that was only provided to the individuals of the highest social class, indicate a diet exclusively of C-4 plants, which is mostly associated with corn consumption. Stable isotope analysis of Muisca human skeletal samples considered to be of lower classes reveal a diet rich in C-3 plants associated with tubers and other plants (Cárdenas-Arroyo 1995: 13). The lower Muisca social classes were not only restricted to eating corn on certain occasions, but also to the form in which it was consumed. The preparation of corn in the form of tamales (*bollos* in Colombia) (Figure 26), where the corn is ground into a dough and then wrapped in the husk and boiled, was the form eaten by the lower classes. When the corn was ground into a dough and flattened into a round shape and then grilled, known as *arepas*, this was provided to was the way the chiefly class (Figure 26) (Patiño 1990: 67). Today *arepa* is the form most commonly consumed by modern Colombians, although *bollos* are also still very popular in some regions of the Atlantic coast. It is clear that corn was restricted to the adult general population and more available to the chiefly classes, expectant mothers, and younger children indicating again that the Muisca had a sophisticated restrictive and preferential diet that was highly organized and controlled.



Figure 26: Corn *bollos* Barranquilla, Colombia (left). Corn *arepas* Bogotá, Colombia.

The majority of the corn produced by the Muisca was destined for the production of *chicha*, a fermented corn beer that was the main beverage consumed by the Muisca (Kurella 1998: 198). There are no related chemical analysis that establish the nutritional values of the *chicha*, but it is noticeable when you drink it that is very filling and, given that is based on corn, it must have some of the nutritional characteristics of this cereal. In order to ferment the corn, young Muisca women would chew some grains and spit them back in to the dough, beginning the process of fermentation (Patiño 1990: 72). The dough was then boiled for a few hours and placed in large ceramic *ollas*, where it was fermented for months at a time. Oviedo (1852: 162) commented that because the water the Muisca drank was of poor quality and unhealthy, they would drink *chicha* instead, thus preventing sickness caused by contaminated water. *Chicha* was consumed by the elites, but it was also accessible to the general population during communal projects and during feasts. At the site El Infiernito (Figure 27) near the modern town of Villa de Leyva, Boyaca, the Muisca constructed an impressive observatory; stone monuments were erected in the form of phallic symbols, possibly in relation to ceremonies related to fertility where the distribution of *chicha* was a common event.



Figure 27: Archaeological site El Infiernito near Villa de Leyva, Boyaca Colombia. Muisca observatory (left). Phallic symbols indicating fertility rites (right).

At this site archaeological excavations led to the recovery of large amounts of ceramics utilized for the processing and consumption of *chicha*, including large *ollas* for its preparation and *mucuras* ceremonial jars (Figure 5) used for serving this drink. This beverage was massproduced for a large number of people when communal consumption of this beverage was the main event in feasts dedicated to fertility ceremonies (Salge 2007: 20). In the majority of Muisca rituals, rites of passage and other celebrations, such as weddings, used *chicha* in a fundamental role (Salge 2007: 21). For instance, as described by Simón (1981 [1625] III: 198), “the bride will offer *chicha* to her husband to be as a symbol of the fundamental new life that awaits them.” During these festivities, the Muisca men formed a circle that represented the sun and danced; the women in the center of this circle distributed the fermented drink, indicating the important religious significance this drink had in every Muisca celebration (Salge 2007: 21). In Colombia the introduction western beer led to a partial replacement of this traditional drink; and, during the 1900’s, the government implemented a sanitary law that prohibited the production of *chicha* for a product that would cost ten times more (Patiño 1990: 72). The implementation of this law did not completely eliminate the production of this beverage. Indigenous and *ladino* populations continued to produce this beverage for their local consumption and for traditional

practices and celebrations. Corn continues to be part of the diet of the majority of the population in Colombia. Muisca corn varieties (Table 1) are still cultivated, including the *pollo* variety (Figure 28, Table 6). Corn is sold in the majority of markets in different forms: fresh, dry, and processed (ready for preparation of *arepas* and *bollos*) (Figure 28).



Figure 28: *Mazorca pollo* variety (left). Processed corn for *arepas* or *bollos* (right) Bogotá, Colombia.

#### Methods for the Preparation of Corn

The Muisca called corn *aba* (Garcia 1948a and Lugo) but had specific grammatical variations to refer to different types of corn. “White corn was referred to as *Fuquie pquihyza*. Black corn: *Chyscamuy*. Yellow corn: *Abtyba*. Red corn: *Sasamuy* and soft corn: *Phochuba*” (Viricoechea 1871:169, and Jiménez de Quesada 1962 [1545]:277). Rozo (1998: 62) explains that when corn was not used to make *chicha*, the Muisca roasted the grains to make corn flour for soups or for dough to make *arepas* and *bollos*. The simplest form for eating corn was raw or grilled. Corn was also utilized to make *bollos* or tamales and the chiefs gave these with *chicha* to the general population as a repayment for communal services or to individuals of a particular status. “*Bollo*: A paste of corn flour and grease that is kneaded like bread to form a cylinder of white dough about a palm and a half in length and are rolled in the corn husk or of other plants and are boiled and sold all around, and it is the common bread that the slaves and the Indians

eat” (Alcedo 1789:127). The *bollo* (Figure 26) was the general form in which the common population consumed corn and shows that a restrictive diet was not only enforced in the type of foods used but also in the forms these foods were prepared. Corn was also eaten in soups, as is done today all around Colombia (as in the *ajiaco* and *sancocho* described earlier) as well as in the *mazamorra*, a type of cream corn. There are no detailed descriptions of how these soups were prepared by the Muisca in the Spanish chronicles, although it is possible that they were prepared similarly to modern preparations in Cundinamarca and Boyaca, Colombia.

Another common form of corn preparation was the traditional *arepas* that today are eaten in all the regions of Colombia. “*Arepa* in Chibcha: *Thytafun* or *Thyta fun*” (Viricoechea 1871: 115, and Jiménez de Quesada 1962 [1545]: 193). The Muisca prepared the *arepas* from the corn dough and utilized either dry corn or fresh corn. Generally, *arepas* are made into a round flat shape and then grilled, but there are a wide variety of types such as: *choclo* where the fresh corn is used and these are usually sweet and yellow in color; *pelado* where the corn is first dried in mineral lime powder in order to remove the coat on the grains and then fried; and white *arepas* (Figure 26) which are the most common where the dry corn is made into a flour that is mixed with water to become dough that is made into a round flat shape and grilled. During the Muisca period *arepas* were generally eaten by the chiefly class and restricted from the general population (Rozo 1998: 63), but this rapidly changed during the Spanish conquest when *arepas* became the main staple food in the country; today, these corn delicacies are considered the tortillas of South America.

#### Chenopodium quinoa: Quinoa

Quinoa originated in Peru (Langebaek 1994: 4), where it was first cultivated 5000 years ago (Bravo *et al.* 2005); it is a major source of protein that is of such a high quality that it often

replaced meat in the diet of indigenous peoples in Peru, Bolivia, Ecuador, and Colombia (ACTIBS 1989:149). It appears that the Muisca intensively cultivated quinoa in their raised fields. Because its use was not restricted like corn, it was commonly used by the general population (Raichel-Dolmatoff 1965: 159; Labbé 1986: 154). Pollen analysis at the Sabana de Bogotá, during excavations at the sites of Cota and Suba and from samples found in raised fields cultivated by the Muisca, show the presence of *Chenopodium* pollen dating to the early Muisca period (Boada 2006: 133). This is the only type of archaeological evidence for quinoa in Muisca territory, as macro samples of this cereal have never been found in Muisca sites. The lack of archaeological evidence does not allow us to understand completely how this cereal was used or when it was introduced to Muisca territory from its place of origin in Peru.

There are no references in the Spanish chronicles to this cereal, which raises doubts about the use of this crop by the chiefdoms in Cundinamarca and Boyaca. Nevertheless, wild and cultivated varieties of quinoa are commonly found in this territory in the present, and it is not believed to have been introduced by the Spanish or later inhabitants of the region so it is almost certain that the Muisca did cultivate this crop. Patiño (1990: 62) suggests that quinoa was cultivated by the Muisca “and even if the contemporary documents of the period do not support this affirmation, recent archaeological studies have shown the presence of *Chenopodium* pollen in the region.” Quinoa was also documented in later sources indicating that this cereal was cultivated in Cundinamarca in 1833; this date is the earliest documentation we have for this crop in the region (Vergara y Velasco 1974: III 1129-1130). It appears that the Muisca also utilized quinoa for the preparation of alcoholic fermented beverages, as it was done by indigenous societies in Peru (Cobo 1956 [1639]: 162).

Usually, quinoa (Table 1) is cooked like rice; it is also used to thicken soups. The grains are also toasted or grounded into flour and boiled or fermented into beer (ACTIBS 1989: 153). In Peru and Bolivia it is commonly used to make baked goods and bread. The leaves of the quinoa can also be eaten or used for animal feed. The nutritional value of quinoa is incredibly high as it contains a better amino acid balance than most true cereals and even meat; it includes lysine, methionine, and cysteine as well as carbohydrates (ACTIBS 1989: 149-153). The popularity of quinoa in Colombia decreased dramatically after the conquest but recently it has been grown largely for its nutritional quality and now is commonly found in traditional produce markets as well as in supermarkets around the country. During 2001, it was questioned why such a valuable crop had not become a staple food and, although its cultivation has increased during the last ten years, agriculture was still dominated by other crops because it is difficult to change entrenched eating habits that focus on corn, wheat, and rice (Brintnall and Conner 2001: 462).

A new dietary trend in eating healthy foods has dramatically spread the use of quinoa in developed countries. In the United States quinoa is now increasingly popular (Murphy 2011) and can be found in many supermarkets. This grain is distributed by big firms such as GOYA and Whole Foods and is commonly offered in restaurants. More than 4500 tons of quinoa are imported to the United States every year from Bolivia and Peru, demonstrating that this cereal is quickly being adopted (Brintnall and Conner 2001: 462). Quinoa can be grown from elevations ranging from sea level to 4,000 meters above sea level and there are more than eight varieties depending on the elevation it is grown: the valley type, altiplano, salar, sea level type and subtropical type with colors ranging from red, to brown, to yellow, to orange, to purple (ACTIBS 1989: 154). Sea level quinoa is grown in the United States and its resilience means it can grow at various elevations, allowing farmers to cultivate this nutritional crop in marginal lands. Quinoa's



recent popularity is improving the livelihoods of farmers that produce this crop: “Before people didn't go to study, they were born, they grew up, and that was it. They went on to herd sheep and llamas. Nothing more, now people here, we think about doing something with our lives” (Murphy 2011). Yet, the increased popularity of quinoa can also have a detrimental effect for native populations that use this crop. The increase in the demand for quinoa has raised its price about seven times in Bolivia, where it is a staple food and made it harder for Bolivians to purchase it. “And if prices keep climbing, quinoa could stop showing up in traditional soups and porridges in Bolivia.” (Murphy 2011). Thus, it is necessary to reach a balance in production for export, while maintaining the supply of quinoa for the local populations that depend on it. In Colombia this crop is sold as dried grains at produce markets in the country (Figure 29, Table 6).



Figure 29: Quinoa grains Bogotá, Colombia.

## Legumes

### Phaseolus vulgaris: Frijól, Common Bean

This species of bean (Table 1) was first domesticated in Mexico, Central America and in the central Andes of South America in Peru and Colombia (Britnall and Conner 2001:143). This

important crop was domesticated independently by the pre-Columbian societies in the central Andes of Colombia, ancestors of the Muisca who continued to grow this legume so that it became an essential part of their diet. The earliest evidence of domesticated beans in South America come from the coastal valleys of Peru dated to 4400 years ago and to 2500 years ago in Mexico (Britnall and Conner 2001: 149). Archaeological Muisca sites in the Bogotá Sabana show the presence of pollen belonging *Phaseolus vulgaris* dating to 1100 BC (3050 +/- 40 AP) in Guaymaral, 500 BC (2450 +/- 40 AP) and 450 AC (1510 +/- 40 AP) in Filomena, representing evidence for the early and continuous use of this legume in the region (Boada 2006: 49). The Spanish chronicles describe corn as the only crop being cultivated on the raised field system of *camellones*, but the presence of *Phaseolus* pollen in samples taken from Muisca raised fields suggest otherwise (Boada 2006:133).

Most likely the *camellones* were utilized for growing multiple crops on the same field and not monocropping, as the sources suggest. This agricultural technique has important benefits such as a more stable preservation of the soils, a reduction in the quantity of weeds and pests, and in crop continuity, although this practice has dissappeared in Colombia altogether. This mixed cropping is also advantageous for corn, since beans are associated with nitrogen-fixing bacteria essential for this cereal (Britnall and Conner 2001: 149). Multi-cropping was commonly utilized in the Americas before the arrival of the Europeans (Langebaek 1987: 61) and today is still practiced in the Bogotá Sabana by the local farmers throughout the region (Boada 2006: 133). Bean plants grow fast and are ideal to grow along with corn. They complement each other in nutritional terms and these two crops were of extreme importance for the chiefdoms (Labbé 1986: 154). “The Muisca agricultural economy was based on corn and beans” (Kurella 1998: 198).

According to Langebaek (1987), fortysix percent of all the Muisca captaincies cultivated beans and this was the third most cultivated crop after corn and potatoes in the chiefdoms. As with many other plant species, the Muisca cultivated multiple varieties of this legume. In excavations at the site of La Muela, a total of 33 bean seeds were recovered and analyzed. At least three distinct varieties were present: *Huacaloma*, *San Rafael*, and the *Tunja* varieties (Pradilla *et al.* 2005) (Figure 30, Table 1). The Spanish chroniclers also described the presence of beans in the Muisca chiefdoms. Fray Pedro Simón's (1981 [1625] III: 96) account of the welcome the Spanish received when they encountered the Muisca is as follows: "...y les traian a los nuestros de todo lo cual abunda aquella tierra con mucho maiz, frisoles y raices de muchas maneras" (...and they will bring to our people everything they have in abundance in that land corn, beans, and roots of many forms).

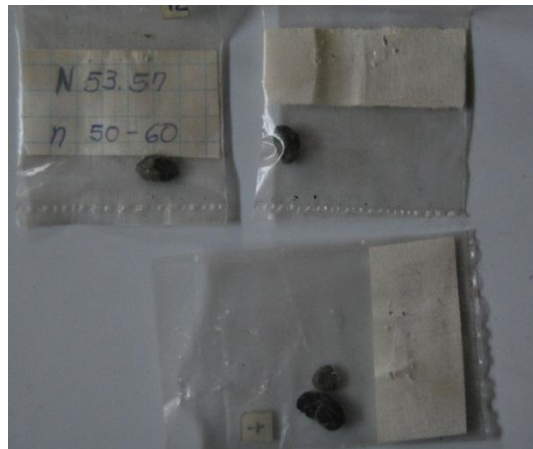


Figure 30: Burned bean seeds recovered at the site of La Muela Tunja, Colombia by the UPTC representing the varieties: *Huacaloma*, *San Rafael* and *Tunja*.

After the conquest beans continued to be of importance for the human population of the northern and central Andes. Today common beans are the most widely cultivated species of legume in the world (Britnall and Conner 2001: 149). In Colombia the common bean (Figure 31, Appendix B, Table 7) is the most important legume in the daily diet, especially for families with

scarce resources. It is considered the cheapest resource with proteins and calories they can find (Bravo *et al.* 2005). In the produce markets of Paloquemao in Bogotá and Tunja the cost of one pound of fresh common beans range between 700 to 1,000 Colombian pesos or around .50 USD. These legumes can be purchased as dry seeds, fresh seed, or fresh in the pod. Beans are eaten in the entire country in abundance and are utilized in many traditional recipes, such as the *bandeja paisa*, the main traditional dish in the Department of Antioquia, Colombia. In Cundinamarca and Boyaca beans also form part of the daily diet and they are usually added to soups. Beans are utilized by the entire range of social classes and it is also possible this was also the case during the Muisca period.



Figure 31: Common bean *San Rafael* variety Bogotá, Colombia.

### Arachis hypogaea: Peanut

Although peanuts (Table 1) are usually associated with nuts they are really legumes. Native societies in South America probably ate them in much the same manner as beans. The domestication of this legume possibly occurred first in southern Bolivia and northern Argentina; by the time of the arrival of Columbus to America, peanuts were cultivated in many warm regions of South America (Britnall and Conner 2001: 150; Langebaek 1994: 4). Peanuts were utilized by many indigenous groups, including the Muisca before the arrival of the Spanish (Domínguez 1981: 87). Peanuts were grown in the Colombian Andes and in the Alto Magdalena, although they were introduced to these regions from the Llanos Orientales where they diffused extensively, indicating they were grown there before the Muisca had access to this legume (Patiño 1964: 161). This crop is not mentioned in the Spanish chronicles as a Muisca food product nor found at any of the archaeological sites in Cundinamarca and Boyaca. Nevertheless, it is very likely that peanuts were utilized by the Muisca, especially as native societies in the Llanos who cultivated this crop were subjects of the Muisca chiefs of Sogamoso and Tunja (Castellanos 1955 [1601], IV: 221). In Colombia, as is the case all around the world, peanuts have become one of the most consumed legumes and are subject of extensive agricultural research for their high protein content, their resilience to grow on poor soils, and their ability to thrive in tropical environments (Britnall and Conner 2001:150).

### Erythrina edulis: Chachafruto or Balú

*Chachafruto* is a legume that grows in trees, can reach 14 meters in height, and can live between 30 to 40 years (Bravo *et al.* 2005). It grows at elevations ranging from 1200 to 2600 meters above sea level. This tree is native to the Andean region from eastern Colombia to

southern Bolivia. It is a semidomesticated and wild forms are abundant in Colombia, so it is very likely that the Muisca and other indigenous pre-Columbian groups used it for food (ACTIBS 1989: 166). The *chachafruto* (Table 1) is considered a miraculous plant by some indigenous people for its medicinal uses and as a super food for its high protein content and its quality and balance of amino acids (Bravo *et al.* 2005). Its leaves, flowers, pods, and fruits are edible. The indigenous people that had access to this food probably used it efficiently. Archaeological evidence of this legume is lacking in Colombia, but seeds have been found in early burial sites in Peru (ACTIBS 1989: 170). Rozo (1998: 31) explains that, although this legume is not mentioned on any of the sources as a Muisca crop it should be added to the list of foods utilized by this chiefdom society.

This legume is not commonly utilized by the modern population in Colombia, but it is sold in the market of Codabas in Bogotá for 2,500 Colombian pesos per lb. or around 1.25 USD, although it is not easily found (Figure 32, Appendix B, Table 7). This legume has great potential for becoming a staple food in the Andes, as the tree is very easily grown. “Because of its off-season seed production, basúl is potentially vital for health and survival in times of food scarcity. It is also promising for use in reforestation, one of the most pressing of all environmental concerns” (ACTIBS 1989: 167). This legume is usually boiled with salt and then eaten with corn and tubers. Chachafruto could be an important dietary addition to the dinner tables in Colombia, as its seeds contain 20% protein, essential amino acids, and phosphorus (ACTIBS 1989: 168).



Figure 32: Chachafruto seed Bogotá, Colombia.

### Inga feuillei: Guama

Compared to the other Muisca legumes, the part of *guama* that is eaten is not the seeds but the fruit itself. These fruits also grow inside pods like beans and peanuts, but unlike those legumes that are vines, *guamas* grow as trees up to 15m high (Bravo *et al.* 2005). The long hard pods of *guamas* contain a white silky fruit encasing a large black hard seed (Figure 33). The silky casing is a delicious sweet substance that appears to melt in your mouth and can be compared to cotton candy. These fruits are eaten fresh today and this was probably the case before the conquest (Table 1). It appears that this plant originated on the eastern slopes of the Andes, including parts of Colombia and were later introduced to coastal regions in Peru in ancient times, given that the pods of this plant are represented in pre-Columbian pottery dating to approximately 1,000 BC (ACTIBS 1981: 283). The presence of this fruit in the Muisca diet is listed in the *Descripción de la Ciudad de Tunja* (1943 [1610]: 455). The Muisca possibly obtained this fruit from lower elevations, including those outside their territory and most likely traded some of their products, including salt for the fruit. *Guamas* grow at elevations from sea level to 1500 m, they can resist temperatures above 33°C, and they tolerate highly acidic soils with aluminum saturation as well as high amounts of water often growing in swampy areas (ACTIBS 1981: 284).



Figure 33: *Guama* fruits, seeds and pods Neiva, Colombia.

## Fruits

The pre-ceramic societies of Cundinamarca and Boyaca that inhabited this region around 10,000 years ago based their subsistence primarily on the collection of wild fruits and seeds over the consumption of meat, as hunting was a secondary activity; the Muisca, considered an agricultural society, in reality had a mixed diet composed of animal and vegetable protein as well as wild fruits (Cárdenas-Arroyo 2002: 14). Fruits were of extreme importance during the early human occupation in the Bogotá Sabana and Tunja and continued to be of great importance during Muisca occupation. Microverticality allowed the Muisca to have access to a wide range of fruit species in their diet from tropical fruits growing at very low elevations to fruits that include a wide variety of berries that grow at elevations of up to 3500m above sea level (Kurella 1998: 198). The Spanish sources do not explain the importance that fruits had in the Muisca economy, but it is clear that, before the arrival of the Europeans, fruits were utilized widely by the native societies (Langebaek 1987: 65). Fruits were an important source of calories, minerals, and vitamins in the Muisca diet and the majority were eaten fresh from the trees (Rozo 1998: 65). It has also been documented in the chronicles that fruits were seasoned (*Sazonar*), although it is not known if this was a preparation of sweets, preserves, marmalades, or a different way to preserve them: “*Sazonarse la fruta. Aiensuca*” (Viricoechea 1871: 194). The Spanish were also introduced to the fruits the Muisca utilized, but as the native populations declined and new agricultural and food production methods developed, the fruiting trees that got eradicated were never replaced, leading to an irreparable reduction of fruit sources (Patiño 1977: 108). Today native fruits are commonly found at the produce markets in Colombia and are widely utilized by the modern populations once again (Table 1, Table 9).



## Shrub and Vine Fruits

### *Curcubita maxima* and *pepo*: Ahuyama and Calabaza

These squash varieties (Table 1) were possibly the most important and the earliest domesticated fruits of the Muisca, but it is also been suggested that these fruits were not that important in the chiefdoms (Kurella 1998: 198). The earliest archaeological evidence of *Curcubita* in Muisca territory comes from the site of Zipacón, Cundinamarca, where samples of a squash were recovered and dated to 3860 +/-35 BP (cal 2300 +/-35 BC) during excavations conducted by Correal (1990: 261). In the site of Aguazuque, Cundinamarca the remains of *Curcubita pepo* were recovered in association with the third zone of occupation with a chronology of 3850 +/- BP (cal 2345 BC-cal 2240 BC)(Cárdenas-Arroyo 2002: 57). This evidence suggests that squashes were early contributors of the Muisca diet and of early peoples in the Bogotá Sabana. *Curcubita* phytoliths in the form of elongated segments were identified in the dental calculus of a Muisca individual in Tunja, Boyaca, demonstrating the presence of this fruit during Muisca occupation (Parra 1998: 22). This Muisca individual (Tunja 4), a female of approximately 30 years of age, came from a common burial, suggesting that *Curcubita* was available to the general population (Parra 1998: 22). The Muisca utilized this fruit for a variety of dishes, such as *taque*, a pickled squash combined with *ibias*, *chuguas*, and other vegetables that was fermented for two weeks in a clay pot and eaten with meats and tubers (Rozo 1998: 66). The leaves and flowers of the *ahuyama* were also utilized in stews combined with corn, a meal that was served for breakfast (Rozo 1998: 66). Langebaek (1987: 65) explains that according to the Spanish chronicles the Muisca generally utilized the *ahuyama* and the squash in their diet, although it was mostly used by the lower social classes.

In the *Descripción de la Ciudad de Tunja* (1943 [1610]: 455) *ahuyamas* are described as a staple food of the Muisca, emphasizing the importance of this fruit there. The chronicler Simón (1981 [1625].I: 242) also describes the presence of this crop in Bogotá and the adjacent regions during the arrival of the Spanish to the area in 1537. According to Zamora (1980 [1701]: 43), the “*ahuyamas que son vnas grandissimas calabazas de mas de seis dedos de canto, la carne anaranjada de buen gusto y alimento de los pobres*”. This chronicler refers to the *Curcubita maxima* (Figure 34) as an enormous squash more than three feet in length with a tasty orange meat. This is noted as being the food of the poor, emphasizing the idea that squashes were considered food for the lower classes. Boada (2006:133) also states that *ahuyama* was considered food for the lower classes during the Muisca period.



Figure 34: *Ahuyama* Villa de Leyva, Colombia notice the large size of the fruit (left). *Ahuyamas* at the produce market in Tunja, Colombia.

The *Curcubita maxima* originated in the northern and central Andes and has the largest fruits known for a plant species, some weighting in excess of 50kg and reaching a meter in diameter (Bravo *et al.* 2005). This large size allows for an entire family to sustain themselves for many days with just one fruit. This squash is commonly utilized in the modern Colombian cuisine and has a high nutritional value. It is also utilized for its medicinal value, as many Colombian doctors affirm that it is the best type of food for people suffering from ulcers or

whom have been operated on for digestive and intestinal problems (Bravo *et al.* 2005). The seeds of the *ahuyama* are also eaten after being roasted. The *Curcubitas* are easily cultivated and are little bothered by pests or heat, making them ideal for cultivation in many environments. These crops can also be stored for months, even years, without special care, a quality that is used by the modern population in Colombia and that was possibly used in antiquity by the Muisca. The fruits are usually baked or boiled, sometimes made into a puree known as *mute de ahuyama* in the Atlantic coast of Colombia, and are also added to soups in Cundinamarca and Boyaca. The squashes are highly nutritious and are an excellent source of vitamin A, C, iron, and potassium (ACTIBS 1989:203). In the markets of Paloquemao in Bogotá, Tunja and Villa de Leyva *ahuyama* can be purchased for 1,000 Colombian pesos per lb. or approximately 50 cents. A wide variety of *Curcubitas* are grown today in Colombia. In addition to the *ahuyama*, I was able to purchase a rare green variety of *C. pepo* at the Paloquemao market in Bogotá (Figure 35, Appendix B). Today in the Andes, as in some other parts of the world, squashes are still considered to be food for the poor (ACTIBS 1989:210). However the important qualities of these fruits, such as their high nutritional value, easily cultivation, and their preservation for storage, are changing this concept rapidly and these crops are becoming highly valued by modern populations.



Figure 35: *Curcubita pepo* green variety Bogotá, Colombia

*Capsicum* sp.: Ají or Pimiento

Peppers have become one of the most diverse types of fruits around the world. They can be found in a great variety of shapes, colors, and flavors and are used as the number one spice ingredient in all the continents (ACTIBS 1989:195) (Figure 36). The location of the origin for peppers is still contested; some researchers place them in Mexico dating to 7,000 BC (Britnall and Conner 2001:76), while others suggest an origin in the countries of Bolivia and Argentina (Pearsall 1992: 181-187), from where they quickly spread and reached Central America and Mexico in very early times (ACTIBS 1989:195) (Table 1). There is no archaeological evidence for peppers in Colombia, although many species of *Capsicum* had already been domesticated in South America by at least 7,000 BC; and, their presence in Colombian territory at an early period is almost certain (Cárdenas-Arroyo 2002: 19; Labbé 1986: 154). Domínguez (1981: 85) explains that the early domestication of primitive forms of *ají* in Colombia were for use as condiments and that later these were transformed and hybridized into the cultivated forms we find today. The small number of wild species of peppers point to an ancient origin of this crop.



Figure 36: Varieties of peppers sold at the Codabas produce market Bogotá, Colombia.

The Tunebos of Boyaca, descendants of the Muisca, use peppers frequently in their diet, particularly as a condiment for meat and as side dish for tubers (Uscategui 1963: 94). The

proximity of the Tunebos to the Muisca chiefdoms indicates that peppers were possibly utilized by the Muisca in the same manner as the Tunebos use them today. Ethnohistoric references note that peppers were utilized in large quantities by the Muisca when potatoes were eaten (Vargas Machuca 1892 [1599]: 162). According to Langebaek (1987: 59, 64) the Muisca grew peppers in the captaincies of Chicamocha, Chitagota, Chusbita, Guacha, Mona, and Ocavita in Cundinamarca and Boyaca. Rozo (1998: 34) described the different varieties of peppers utilized by the Muisca with their respective names in Chibcha as: “*Ají Quybsa*, long and big *Pquata quybsa*, round *Nymqua quybsa*, yellow *Guapa quybsa*, small (possibly *pajarito*) *Agua quybsa*”. According to this same author, the general method to eat the peppers by the Muisca was to just chew the fresh fruits.

Peppers are grown in warm climates and were used as a condiment in central Colombia. One of the main advantages of peppers is that they can be stored for long periods of time and are easily transported, which could have been beneficial for trade during the Muisca period (Correal 1990: 248). Today in Colombia there are a great variety of pepper species that can be purchased in the different produce markets throughout the region. The average cost of the peppers in the markets of Bogotá and Tunja is around 1,500 Colombian pesos about .75 USD per lb. In terms of the national native species found in Colombia, the Rocoto *Capsicum pubescens* (Figure 37, Table 10) is the most widely cultivated; this species is hot in flavor and is commonly used to make hot sauces (ACTIBS 1989: 196). This species can vary greatly in color from dark red, to orange, to yellow to brown, although the most common colors found are red and orange. Another widely used pepper is a very small species about 1.5 cm in length commonly known as *pajarito* (Figure 38, Table 10), this is a wild *Capsicum* species that is green to orange in color and very spicy. It is also used to make hot sauces that are added to a variety of foods, especially

*empanadas*. Today in Colombia you can find a great variety of peppers, both imported and national, so it is very difficult to determine which species were native to the region. As in ancient times, peppers continue to be widely used in the Colombian cuisine.



Figure 37: *Aji Rocoto-Capsicum pubescens* Bogotá, Colombia.



Figure 38: *Aji pajarito* wild species of *Capsicum* used in the preparation of hot sauces in Colombia.

Annanas comosus: Pineapple

Pineapples are native to the central Andean region of South America (Langebaek 1994: 4) and were widely cultivated and utilized by the pre-Columbian indigenous people in Colombia (Table 1). It is believed that the Guarani in northern Paraguay and southern Brazil were the first to domesticate the pineapple, although “pineapple exhibits greatest variation in western Amazonia, particularly in Peru and Colombia” an indication that it could have been domesticated in these countries first (Smith *et al.* 1992: 107, 108). Columbus described these fruits, noting their similarity to pine cones which led to the common English name we use today (Brintnall and Conner 2001: 91). “Pineapples were obtained by the Muisca from the lower valleys” (Labbé 1986: 154). This fruit can be cultivated from low elevations up to 2000 meters above sea level and was utilized by the Muisca. It is commonly used today by their descendants, the Tunebo Indians of Boyaca, who ferment this fruit into *guarapo* an alcoholic beverage (Langeabek 1987: 64). The archaeological presence of pineapples in Muisca territory continues to be missing, but future projects might identify this fruit in Muisca sites. Domínguez (1981: 87) also mentions the presence of this fruit in Muisca agricultural fields. According to Langebaek, pineapples were grown in the Muisca captaincies of Súnuba and Pausagá in Cundinamarca and Boyaca. There is a widespread description of pineapples as a Muisca food in the Spanish chronicles.

Oviedo (1852: 389) mentions pineapples in his account of the Muisca chiefdoms and pineapples are also mentioned in the *Descripción de la Ciudad de Tunja* (1943 [1610]: 455) and by Zamora (1980 [1701]: 114). This fruit began to be spread around the world in the 1500’s by Portuguese, Dutch, and Spanish traders, and it was introduced to Hawaii in the early 1800’s where the majority of pineapples came to the continental U.S., although this changed as tourism replaced this industry there. This fruit is now grown mainly in Africa and Central America



(Brintnall and Conner 2001: 91). In Colombia pineapples (Figure 39) are used in juices, desserts, and in *guarapo*, which continues to be very popular (as it was before the conquest); however, eating the fresh fruit is the most common form of consumption. In Colombia 9,225 hectares of pineapple are cultivated every year with a production of 369,000 tons a year (Acosta and Moreno 1991: 24).



Figure 39: National pineapples at the Codabas market Bogotá, Colombia.

*Physalis peruviana*: Uchuva

The goldenberry (Figure 40, Appendix B, Table 1), as this fruit is known in English, is a relative of the tomato and the two fruits are very similar, with the difference that the *uchuva* is yellow and much smaller. The origin of this fruit is obscure, but it grows wild in the Colombian Andes of Boyaca and Cundinamarca above 2200 m. of elevation in Muisca territory (ACTIBS 1989:251). The chronicler Zamora (1980 [1701]: 114) mentions the *uchuva* as a Muisca fruit, supporting the fact that this society had access to this delicacy. In Colombia these fruits are found all around the country, but they are mainly cultivated and sold in Cundinamarca and Boyaca (Table 9). In the produce markets of Bogotá and Tunja these sell for 1,800 pesos or



around .80 USD per lb, which makes them relatively affordable for the general population. This fruit is shaped like a sphere; it has a meaty texture and is dark yellow in color with an abundant quantity of white seeds (Bravo *et al.* 2005).

In Colombia the *uchuva* is usually eaten fresh and also added to salads. They are also used for preparing traditional desserts (Figure 41) and jams (Diaz *et al.* 2008: 64). The goldenberry is a great source of vitamin A (3,000I.U. of carotene per 100g), vitamin C, B-complex (thiamine, niacin, and B12), high protein, and phosphorus (ACTIBS 1989: 244). Colombia could easily add this fruit to its already large fresh-fruit exports. The high nutritional value of this plant, its beautiful appearance, and exotic flavor makes it an excellent candidate for worldwide consumption and it should be of particular interest for up-scale restaurants and grocery shops. This plant is also easily grown, tolerates poor soils, is easily grown from seeds or cuttings, and matures quickly, all characteristics that makes this fruit an ideal addition to horticulture in regions outside of its native Andes (ACTIBS 1989: 243).



Figure 40: Goldenberries Bogotá, Colombia.



Figure 41: Goldenberries in their husk (left). *Dulce de uchuva* a traditional dessert of Colombia.

### *Solanum quitoense*: Lulo

Another relative of the tomato and the goldenberry is the *lulo* (Table 1, Table 9), one of the most popular fruits in Colombia. The juice from this fruit is considered the national beverage of the country and it has been described as “the nectar of the gods”. This fruit originated in the Colombian Andes and is thought to have been domesticated in the last few hundred years (Bravo *et al.* 2005), which means that, if the Muisca had access to this fruit, it was as a wild variety. Fray Alonso Zamora (1980 [1701]: 118) describes *lulo* as a Muisca product, but there are no other sources or archaeological evidence to support this statement, although the presence of wild varieties in the region might indicate that it actually was used in the chiefdoms. The *lulo* fruits were possibly eaten fresh by the indigenous people of Colombia, although the possibility that the pulp of the fruit was added to water and drank (as it is done in modern times) cannot be excluded (Patiño 1990: 164).

There are three varieties of *lulo*: *quitoense*, the most common variety, a spineless form; *septentrionale*, a variety with spines in its trunk and branches; and, *topiro*, a larger fruit (Bravo *et al.* 2005) (Figure 42). The presence of all the varieties in Colombia suggests that *lulo* originated there. *Quitenses* is found also in Ecuador and *septentrionale* is also found in Costa Rica, but *topiro* can only be found in Colombia (ACTIBS 1989:274). The price of *lulo* in the markets of Paloquemao in Bogotá is 2,000 pesos or around 1 USD per lb. and 1,500 pesos in Tunja

(Appendix B). In Cundinamarca and Boyaca 400 hectares of *lulo* are cultivated every year with a production of 8,000 metric tons a year (Acosta and Moreno 1991: 24). This fruit has seen little serious commercial development outside of Colombia and has become scarce and expensive in Ecuadorian and other Andean markets because of the devastation from a nematode pest that affects it (ACTIBS 1989:267). In order to save this native product, it is necessary to conduct research in nematocides and biological controls that is presently lacking. Based on 100g of an edible portion, *lulo* contains 23 calories, 0.6 g of protein, 5.7g of fiber, as well as vitamin A, thiamine, riboflavin, niacin, ascorbic acid and phosphorus (ACTIBS 1989:270). The excellent taste of this fruit has the potential of becoming popular in industrialized countries. Colombia could begin exporting this fruit all over the world, but the pest problems that this crop is having outside Colombia must be addressed in order to accomplish this.



Figure 42: *Lulo* fruit *S. quitoense* Bogotá, Colombia (right). *Lulo* fruit *S. septentrionale* Neiva, Colombia.

#### *Passifloras*: Passion fruits

In Colombia there is a wide selection of species and varieties of passion fruits (Table 1) sold in the local markets, especially in Cundinamarca and Boyaca. These are part of the daily diet of people all around the country and are generally utilized in the preparation of juice. Fruit juice is almost a requirement in a Colombian meal, especially for lunch and passion fruits are

some of the most common fruit juices served. The most popular of these juices is *maracuya* from the *Passiflora edulis*, which has a sour and sweet flavor. Fruits of this plant can be yellow in color, which is the most commonly used, or purple. *P. edulis* is native to Brazil. This fruit only began to be extensively cultivated in Colombia during the 20<sup>th</sup> century and became increasingly popular throughout the entire country (Bravo *et al.* 2005). This passion fruit is the most cultivated species in Colombia and the rest of the world (Britnall and Conner 2001: 103). Even though *maracuya* is the most popular passion fruit in the country, there are also a large selection of native varieties used there.

The Muisca territory is ideal for the cultivation of vines like the passion fruits, as these grow at elevations higher than the 2000 meters commonly found in this part of the Andes. Modern Colombians not only prepare juice with these, fruits but also ice creams, jams, other sweets, and liquors. Native passion fruits are also eaten fresh in some cases. The Muisca likely also ate the fresh fruits, as did the Muzos a pre-Columbian society that inhabited the adjacent regions. Patiño (1990: 68), when referring to this society eating *curuba* (*Passiflora mollissima*), explained that: “the Muzos ate the *curuba* directly as it appears that the use of juice from this interesting plant family was a modification posterior to the conquest”. This species of passion fruit is native to Colombia, Venezuela, Bolivia, and Peru and was domesticated by indigenous groups shortly before the Spanish conquest (ACTIBS 1981: 289). The presence of *curuba* in the Muisca diet is listed in the *Descripción de la Ciudad de Tunja* (1943 [1610]: 455). This fruit was grown in trellis by the Muzos and the Muisca in Cundinamarca and Boyaca (Patiño 1990: 68) as was probably the case for all the cultivated species of *passiflora*, given that they are all vines.

*Curubas* are tubular shaped fruits with yellow, green, or red thin skins and pink to orange interiors (Figure 43, Appendix B, Table 9). These plants are extremely resistant to high

elevations and can grow up to 3500 m above sea level and tolerate temperatures of -5°C (ACTIBS 1981: 289). It is a very productive crop. In Cundinamarca and Boyaca 1,550 hectares cultivated with *P. mollissima* and produces 18,000 metric tons a year (Acosta and Moreno 1991: 62). “Annual harvest in Colombia are said to reach 300 fruits per vine, amounting to some 500,000 fruits per hectare weighting about 30,000 kg.” (ACTIBS 1981: 289). In addition to the common *curuba* (*P. mollissima*), there are also some endemic Colombian species of *curubas* that were possibly used by the Muisca, including: *P. mixta*, *P. tripartite*, the *P. achlimiana* endemic to the Sierra Nevada, *P. ambigua*, and *P. antioquiensis* known as the Colombian passion fruit (ACTIBS 1981: 287-295). The rosy passion fruit (*P. cumbalensis*), known in Colombia as *curuba bogotana*, with a red skin is extensively cultivated in Cundinamarca, originated in this area, and was most likely the species used by the Muisca of Bogotá. The high yield of production and the resilience to high elevations and low temperatures made the *curubas* ideal for cultivation by the chiefdoms of the Andes.



Figure 43: *Curuba* fruits Bogotá, Colombia.

It is now difficult to find in the markets of Bogotá and Tunja the endemic species of *curubas*. During this research, only the common *curuba* was available for purchase, costing 2,000 Colombian pesos per lb. or 1 USD. The local produce merchants and friends mentioned that, although they used to eat some of these species, including the *curuba de indio* (*P. mixta*), *curuba bogotana* (*P. cumbalensis*), and *curuba antioqueña* (*P. antioquiensis*), a few years ago these species were not commonly sold or found any longer. It is of concern that these endemic species are not being used in the local diet and this might cause a decrease in their production and lead to the extinction of these species. Fortunately the common *curuba* continues to be desired throughout Colombia. It has begun to be exported and research projects on this plant's biology and agronomy are being developed (Bravo *et al* 2005).

In addition to the *curubas*, there are four more species of passion fruits native to the Muisca regions that were likely used by these chiefdoms. Unlike the *curubas* these passion fruits have a hard thick exterior and are spherical, usually the size of a baseball. The most commonly found in Colombia is the *granadilla* (*P. ligularis*) (Figure 44, Appendix B, Table 9) an orange fruit with a slimy light gray interior that it is only eaten as a fresh fruit and is not used to make juice. The Spanish chronicles refer to *granadilla* as one of the passion fruits present in the Muisca diet and these accounts prove this fruit was widely used by the chiefdoms prior to the conquest (*Descripción de la Ciudad de Tunja* 1943 [1610]: 455, Oviedo 1930: 56 and Zamora 1980 [1701]: 114). One of the qualities of this fruit is that it can be transported easily thanks to its tough skin. The Muisca possibly used it as a snack when on the move, as is commonly done today by the modern population. In Colombia this fruit is cultivated from 800m to 3,000 m of elevation and it can withstand temperatures as low as -1°C; it is currently being exported to Europe (ACTIBS 1981: 290) with an area of cultivation of 1,851 hectares and a production of



28,000 metric tons a year (Acosta and Moreno 1991: 26). The fact that this fruit can be grown at multiple elevations, resisting high and low temperatures, made it an ideal crop for the Muisca microverticality agricultural system.

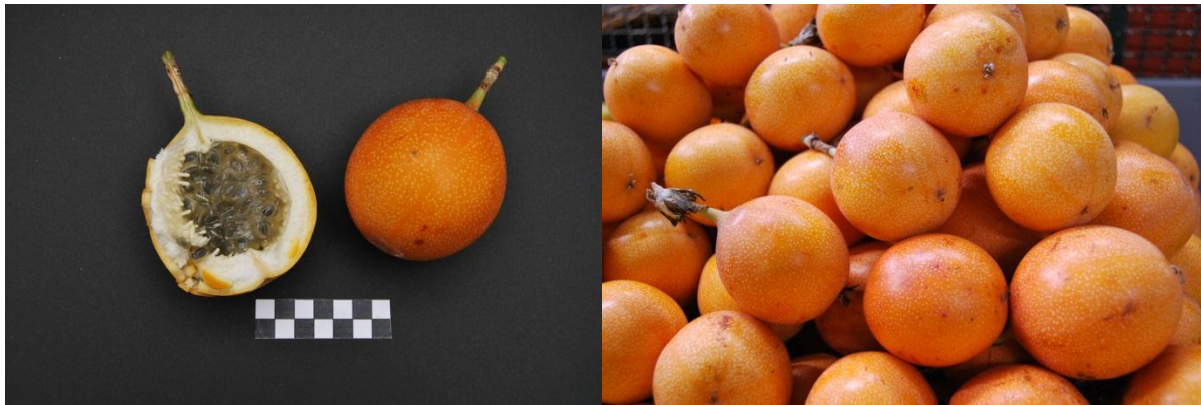


Figure 44: *Granadilla* fruits Bogotá, Colombia

The largest of the passion fruits in Colombia is the *badea* (*P. quadrangularis*) (Figure 45). This species has a hard light green or yellow fruit with thick skin and is found at lower elevations, ranging from 800m to 1500m (Bravo *et al.* 2005) (Appendix B). Cylindrical in shape, its pulp is gelatinous and translucent. The seeds, which are about 200-300 per fruit, are used in the preparation of juice and its cost is 1500 pesos a lb. or .75 US.

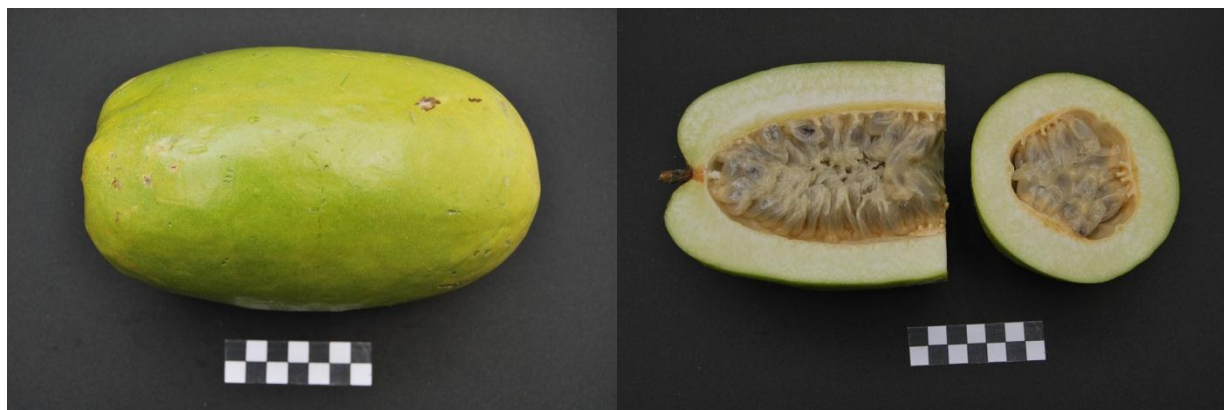


Figure 45: *Badea* fruit Neiva, Colombia

The *gulupa* (*P. pinnatistipula*) (Figure 46, Appendix B, Table 9) is a purple fruit with yellow pulp and grows at elevations between 2500 and 3000 m from Colombia to Chile. They are smaller in size than *granadillas* (ACTIBS 1981: 291). These fruits are rarely found in the markets of the Andes (ACTIBS 1981: 291), but unlike the endemic *curubas*, this species is still found at Paloquemao, Bogotá and in the markets in Tunja. The *chulupa* (*P. maliformis*) (Figure 47, Appendix B, Table 9) is commonly marketed in Bogotá and the surrounding regions. It is a light yellow fruit with white spots. Its skin is strong and thick; to use it, is cracked open, divided in halves and eaten as a fresh fruit or made in to juice. This species is still a wild plant, but it has been successfully cultivated in La Mesa, Cundinamarca, its native region and an area occupied by the Muisca. The cost of this fruit is 800 Colombian pesos a lb. or .40USD. Although the only species of passion fruits described in the chronicles are the *curuba* and the *granadilla*, Oviedo (1930: 56) mentions a variety of passion fruit called *gualchapa* in his description of the Muisca. This could be the *chulupa* or the *gurupa*, as it is described as being similar to the *granadilla* and as growing in the wild.



Figure 46: *Gulupa* fruits Tunja, Colombia.





Figure 47: *Chulupa* fruits Neiva, Colombia.

### Fruit Trees

#### *Persea Americana*: Aguacate

Unlike other fleshy fruits, avocados (Figure 48, Table 1, Table 9) are rich in oil and have the highest energy content of any fruit, about 2500 *cal* per kilogram (Brintnall and Conner 2001: 96). Thus this fruit is a valuable addition to a healthy diet and was probably the reason avocados expanded throughout the Americas. The wild ancestor of avocado has completely disappeared, indicating the early domestication of this fruit. Avocados originated in Mexico at least 7000 BC; from there it was taken to other locations, including Colombia, Venezuela, and Brazil where native peoples began to cultivate it (Bravo *et al.* 2005).



Figure 48: Avocado fruit West India variety Bogotá, Colombia.

It has also been argued that avocados were independently domesticated in different locations, leading to the varieties we find today: the West India variety with thick smooth skin (also known as Florida avocado in the U.S.), the Guatemalan variety with thick warty skin, and the Mexican variety (also known as Hass) with a thin smooth skin (Brintnall and Conner 2001: 96-97) (Figure 49). “The apparent early emergence of three distinct races of avocado supports the idea that avocado was brought into cultivation from genetically diverse and widely separated wild populations (Smith *et al.* 1992: 112). Langebaek (1994: 4) has suggested that avocados were also independently domesticated in Colombia, although recent molecular studies indicate that this is unlikely (Brintnall and Conner 2001: 97). Multiple authors mention avocado as a food product of the Muisca (Domínguez 1981: 87; Roza 1998: 30; Labbé 1986: 154; Langebaek 1994: 4; 1987: 59), but there is no archaeological or ethnohistoric evidence that supports these descriptions. Future archaeological and ethnohistoric research is necessary to demonstrate or reject the presence of avocado in the Muisca diet. Nevertheless, avocado was present in the

Colombian territory when the Spanish arrived and it is likely that the Muisca had access to this fruit through trade networks (Langebaek 1987: 59; Bravo *et al.* 2005).



Figure 49: Avocados of the three known varieties at the Codabas produce market Bogotá, Colombia.

Today avocados are utilized in Colombia (Table 9) on daily basis; these are eaten fresh as a side dish during lunch and are an essential part of the traditional dishes *bandeja paisa* and *ajiaco*. They can be purchased in the majority of markets and supermarkets around the country and are sold by street vendors. They are an important source of income for many families, who sell them depending on their size with prices raging from 1,000 to 3,000 pesos per unit. In Colombia 20,920 hectares are cultivated with avocado with a production of 339,000 metric tons a year (Acosta and Moreno 1991: 48). However, Mexico is the largest producer and consumer of avocados in the world with 906,000 metric tons a year, the United States produces 130,000 metric tons a year which are sold locally and exported mainly to Mexico (Brintnall and Conner 2001: 77).

#### *Psidium guajava*: Guava

Although Langebaek (1994: 4) believes guava (Table 1) had an Andean origin, this fruit most likely originated in Central America where it was domesticated and later transported to South America (Brintnall and Conner 2001: 103)<sup>11</sup>. Once the fruit was established there, the Muisca farmers began to grow it in the warm thermic floors of their domain (Labbé 1986: 154). According to the chronicles, guavas were present in Muisca territory when the Spanish arrived and grown in the captaincy of Pausagá, Cundinamarca (Langebaek 1987: 65). The chronicler Oviedo (1852: 389) describes the use of guavas by the Muisca, but the presence of these fruits does not appear in the archaeological record. These fruits are also mentioned as a Muisca product in the *Descripción de Tunja* (1943 [1610]: 455). “Guavas have a pungent flavor when eaten raw and are more commonly stewed or processed into jams, jellies or pasties” (Brintnall and Conner

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<sup>11</sup> “Given the long association between people and guava, it is probably impossible to establish with any certainty the precise former range of guava” (Smith *et al.* 1992: 151).

2001: 103). In Colombia guavas are very popular and are used in the preparation of juices, sweets, and desserts. However they are mainly used for making *bocadillo*, a traditional sweet of guava and sugar that forms a burgundy paste that is eaten in the entire country and usually accompanied with cheese.

A wide variety of guavas are found in Colombia including the: *pera*, a pear shape fruit with yellow exterior and pink interior; *cimarrona*, similar to the pear but smaller and round; *quito*, also small and sweet; and, the *coronilla* with white pulp and sour flavor used in the preparation of juices (Diaz *et al.* 2008: 27) (Figure 50, Appendix B, Table 9). This fruit is one of the most important crops in the country with a total of 24,920 hectares cultivated with a production of 449,000 metric tons per year (Acosta and Moreno 1991: 24). The majority of guava fields, about 90% of the cultivated land, is unattended and is located in pastures, backyards, and near roads; it is the third largest crop produced in the country (Acosta and Moreno 1991: 45). It can be purchased in the produce markets mentioned earlier for 2,000 Colombian pesos per lb., around 1 USD. Guava is the fruit with the highest content of vitamin C (Brintnall and Conner 2001: 103) and also contains vitamin A and B3 (Acosta and Moreno 1991: 45). It grows in elevations from 0 to 1,800 meters above sea level and continues to be an important crop in Cundinamarca and Boyaca, as it was during Muisca occupation.



Figure 50: Guava fruits *pera* variety (left). Guava fruits white (*coronilla* variety), and red (*pera* variety) Bogotá, Colombia.

### *Cyphomandra betacea*: Tomate de Arbol

The tree tomato (Table 1) is unknown in its wild state an indication of its ancient domestication (ACTIBS 1989: 314). The presence of this fruit is not mentioned in any of the sources as a Muisca food crop, but the fact that it is widely dispersed and utilized by the local populations in the departments of Boyaca and Tunja could indicate that it was actually used by the pre-Columbian chiefdoms there. The place of origin for this fruit is currently unknown, but future research could point to Colombia as it grows in Muisca territory extensively and the majority of the varieties of this species are also found there. “On the Colombian uplands, for instance, it is found in every city, including Bogotá” (ACTIBS 1989: 307). This fruit is usually grown in home gardens in cold areas with high elevations between 1,300 to 3,000 meters above sea level (Bravo *et al.* 2005; Acosta and Moreno 1991: 23).

In Colombia this crop is considered of great importance. In Cundinamarca and Boyaca 580 hectares are planted with this crop with a production of 15,000 metric tons per year (Acosta and Moreno 1991: 24). It is generally utilized to make juices and desserts, after boiling the fruits to easily peel the skin; it is not commonly eaten raw. There is great variety in these fruits based on their color; in the produce markets of Bogotá, Tunja and Villa de Leyva can be found in the red (oratia red ACTIBS 1989: 315), yellow, and común varieties with prices ranging from 1,300 to 1,500 Colombian pesos per lb. depending on the variety (Figure 51, Appendix B, Table 11). These fruits are a good source of vitamin A (carotene 150IU per 100g), vitamin B6, vitamin C (25mg per 100g), vitamin E and iron, with less than 40 calories per fruit (ACTIBS 1989: 310). Tree tomatoes are currently being cultivated in New Zealand with excellent results and have been adapted to some traditional dishes there. Their high vitamin content and their exotic form

and flavor might lead this crop to be commercially successful in other regions outside of the Andes, as is the case in New Zealand.

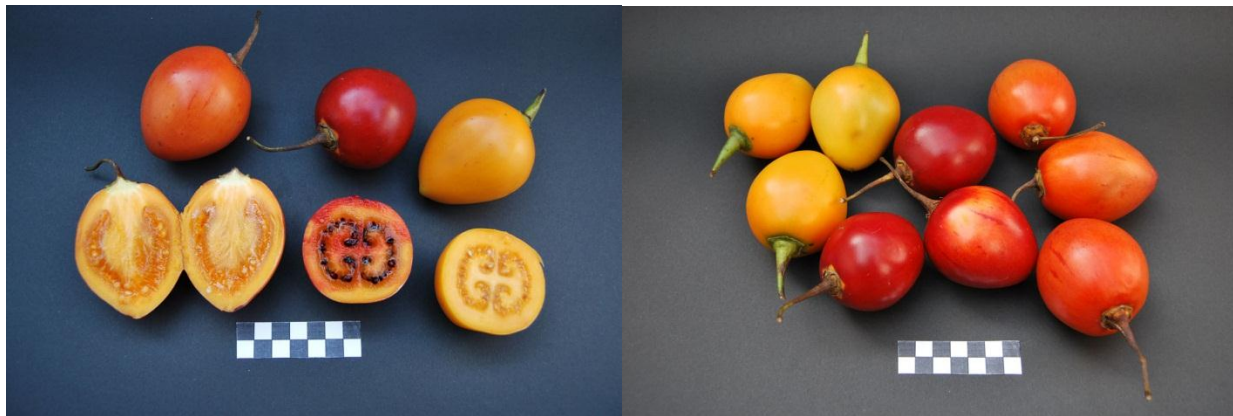


Figure 51: *Tomate de árbol* fruits of the varieties: *rojo*, *amarillo*, and *común* Bogotá, Colombia.

*Annona cherimola*, *muricata* and *squamosa*: Chirimolla, Guanábana and Anón

Commonly referred to as the sops (Table 1), these fruits are native to the Andean region and is composed of perhaps 100 species that includes some of the most delectable fruits in the tropics (ACTIBS 1989: 238). The custard apple (*A. Squamosa*) (Figure 52, Appendix B, Table 9) is the most commonly consumed because selection has led to high quality in the fruits, seedlessness, and an ability of the plant to tolerate a wide range of climates (Britnall and Conner 2001: 99). This species grows in tropical and subtropical climates and is believed to have been eaten by the Muisca before and during the Spanish conquest (Rozo 1998: 31). This fruit splits when ripe and its “white custard like pulp has a sweet, delicious flavor” (ACTIBS 1989: 239). The custard apple is also believed to have originated in Central America and to have been taken from there to Colombia (Bravo *et al.* 2005), although this is not supported by the majority of authors consulted. There are a wide number of varieties of the *anón*, such as the mammoth, *ateira cearense*, as well as hybrid varieties of *A. squamosa* and *A. cherimola* (Bravo *et al.* 2005).



This fruit can be purchased at the markets visited in Colombia for 2,000 pesos per lb. or 1 USD. It is usually eaten fresh and used in the preparation of desserts and sweets.



Figure 52: Custard apple fruit Bogotá, Colombia.

The soursop or *guanábana* (*A. muricata*) (Figure 53, Table 9), as it is known in Latin America, originated in Northern South America in the modern countries of Colombia and Venezuela (Langebaek 1994: 4). It is considered the most tropical of the *Annonaceae* family and has the largest fruit weighting up to 7kg (ACTIBS 1989: 238). Its flesh is similar to the other fruits in this genus, but tends to be whiter and more fibrous. Like the other species in its family, *guanabana* has a high content of vitamins B1, B2, and C, as well as alkaloids useful to arrest the growth of certain cancers and help in healing damaged livers (Smith *et al.* 1992: 202). It is usually used for making juice and is not eaten fresh. The Muisca possibly did not cultivate this fruit in their realm as it grows better at very low elevations, but it reached their territory through trade as has been documented in the chronicles and by contemporary authors (Labbé 1986: 154; Rozo 1998: 30). The chronicler Oviedo describes the Muisca fruits as: “*Hay muchas frutas y todas las que comúnmente hay en las otras partes de las Indias, así como ajos, patatas, guayabas, caymitos, guanábanas e pitahayas...*” (1852: 389). Oviedo describes soursop as a Muisca fruit, demonstrating the presence of *A. muricata* in the chiefdoms. In Colombia this fruit



is sold throughout the country for 3,000 pesos per lb. or 1.50 USD and used to make juice and desserts, such as the *merengon*, a cakelike egg pastry. In Cundinamarca and Boyaca 450 hectares of land are cultivated with a production of 5,000 metric tons every year (Acosta and Moreno 1991: 24).



Figure 53: Soursop or *Guanábana* fruits Neiva, Colombia.

The *Chirimoya* (*A. cherimola*) (Figure 54, Appendix B, Table 9) is considered to be one of the oldest domesticated fruits in the Andes. Controversy has surrounded the origin of this fruit placed by some in Central America, although “was most likely domesticated in highland Ecuador or Peru, and then gradually disseminated in precontact times as far north as Mexico and south to Chile” (Smith *et al.* 1992: 199). Its seeds have been found in archaeological sites in Peru and its fruits are depicted on the pottery of pre-Inca peoples (ACTIBS 1989: 237). Soon after its domestication in Peru and Ecuador, it spread into Colombia and was adopted by native human populations there, including the Muisca (Langebaek 1994: 4). It was utilized by the people of these chiefdoms and probably eaten fresh as it is done today in Colombia (Rozo 1998: 31). Its delicious sweet flavor has given this fruit a great reputation and it has been called the “pearl of the Andes, the queen of subtropical fruits, or deliciousness itself” (ACTIBS 1989: 239). It is

considered by many people to be the finest of all the sops. Its growth is restricted to montane tropical regions between elevations of 1400 to 2000 m, elevations usually inhabited by the Muisca whom probably grew it in their gardens. This fruit has high sugar content with a modest amount of calcium, phosphorus, and vitamin A; it is also a good source of thiamine, riboflavin, and niacin (ACTIBS 1989: 232). In Colombia this fruit is usually eaten fresh, but it is also utilized to make sauces, mousse, custards, ice cream, and wine. It can be purchased in markets and is also sold by street vendors for 2,000 pesos per lb. or 1USD. Some commercial varieties include: the Booth, White, Pierce, Knight, Bonito, Ott and Oxhart. In Ecuador nearly every valley has a local variety (ACTIBS 1989: 237). The exquisite flavor of this fruit makes it a great candidate to become a major product in the global market economy where it can become a valuable crop.



Figure 54: *Cherimoya* fruit Bogot , Colombia.

#### *Carica*: Papayas

Like many other tropical fruits in the New World the origin of Papaya is unknown, but it possibly originated along the eastern flank of the Andes from Ecuador to Venezuela (Smith *et al.* 1992: 163). Papayas and papayuela (Table 1), a smaller variety of this fruit, were cultivated by

the Muisca (Labbé 1986: 154), although this is not supported in any of the chronicles or by archaeological reports from the area. These fruits include a variety of species, such as: *C. candamarcensis*, *C. pubensis*, *C. cestriflora*, *C. chrysophylla*, *C. goudotiana*, *C. pubescens* and *C. goudotiana* - all native species in Colombia (Bravo *et al.* 2005, Smith *et al.* 1992: 168). These fruits grow in herbaceous trees and are highly productive, giving fruit only two years after cultivation and producing from 60 to 200 fruits per tree (ACTIBS 1981: 253). These fruits are generally eaten fresh or in juice in Colombia, but the papauyuelas (Figure 55, Appendix B), actually a bit tasteless, are usually used in the preparation of a traditional sweet dessert (Figure 55) that is commonly prepared during Christmas season. Papayas are difficult to differentiate and place taxonomically, as these species hybridize easily between species, increasing sexual variation (Bravo *et al.* 2005).



Figure 55: *Papayuela* fruit (left and center) and *dulce de papayuela* a traditional Colombian dessert (right) Neiva, Colombia.

### Berries

#### *Vaccinium meridionale*: Agrad

This endemic species of the central Andes in Colombia only grows in the *páramos* of Cundinamarca and Boyaca at elevations between 2000 to 4000 meters above sea level (ACTIBS 1989: 219) in the territory once occupied by the Muisca chiefdoms (Table 1). This wild species, known as the Andean blueberry, is not mentioned in any of the sources, but as an endemic

species of the Muisca Mountains, it must have been collected and utilized as food since the pre-ceramic period. Future research projects might eventually identify this fruit in Muisca and pre-Muisca archaeological sites. During a visit to Lake Iguaque in Boyaca located at an elevation of 3700 m above sea level, I noticed that *agras* grows there and could be found all around the area (Figure 56). The lake Iguaque in Boyaca was considered sacred to the Muisca and the birthplace of human kind (Figure 56). Bachue, the first woman, emerged magically out of this lake and gave birth to a son with whom she then, copulated bringing fourth mankind and peopling the earth. Once the earth was populated, Bachue and her son turned into serpents and returned to Iguaque and disappeared forever (Labbé 1986: 155).



Figure 56: Lake Iguaque in Boyaca (left). Wild *agras* berries at Iguaque (right).

The Andean blueberries (Figure 57, Appendix B, Table 9) are dark purple and round, about 1cm in diameter (larger than must blueberries). They are very sweet and juicy and their skin is tough and difficult to digest (ACTIBS 1989: 219). *Agras* is highly valued in Colombia and it is not easily found; a pound of this fruit costs 25,000 Colombian pesos in the markets at Bogotá around 14 USD and it is the most expensive product of all the ones described in this thesis. This fruit is used in the preparation of preserves, pastries, desserts, yogurts, ice creams, and wine - as well as eaten fresh. In Villa de Leyva and the surrounding regions of the

department of Boyaca the locals travel to the mountains with high elevations in search of this fruit, especially during the months of June and July when the fruit becomes ripe.



Figure 57: *Agras* berries at the Paloquemao market Bogot , Colombia.

*Rubus glaucus*, *Rubus macrocarpus*, *Rubus adenotrichus*: Mora de Castilla, Zarzamora or Mor n and Mora Com n or Silvestre

These South American blackberries (Table 1) are commonly found in the Andean region, where they are native. These fruits are not domesticated and grow wild throughout the region although people cultivate them and market them in large quantities. They are also commonly used in Colombia, especially in the preparation of *mora* juice one of the most traditional beverages in the country. These fruits are also used in the preparation of desserts, yogurt, ice cream, and many other sweet treats that take advantage of the sour flavor of these fruits and creates a great contrast to sweet flavors. The origin of this fruit is found in the high elevations of the South American tropics above 1,000 m. (Bravo *et al.* 2005). It has been suggested that *moras* were used by the Muisca for food (Rozo 1998: 31) and their wild presence in the region supports this.

*Mora de Castilla* (*Rubus glaucus*) (Figure 58, Appendix A, Table 9) is the most popular and numerous of these species in Colombia. Although this is a wild species, it is cultivated extensively in the country where it has become an increasingly important cash crop (ACTIBS



1989: 213). This fruit has the highest concentration of production in Cundinamarca where 600 hectares of this fruit are cultivated with a production of 7,200 tons a year (Acosta and Moreno 1991: 41). In Boyaca the production is of 560 tons a year, perhaps indicating that the Bacata chiefdom of the Muisca used this fruit more often than in Tunja for it is easier to obtain this fruit in Cundinamarca. In Colombia the total production of *mora de castilla* is 11,770 tons a year and Cundinamarca produces more than half of this amount, making this fruit one of the most important agricultural products in the region (Acosta and Moreno 1991: 41). The cost of one pound of *mora de castilla* in the markets of Bogotá is 2,000 Colombian pesos or 1 USD. Colombia already exports this fruit to the U.S., but realistically this fruit is barely known outside of the Andes. These berries are very juicy. In Colombia the majority of the fruit is made into juice, which is popular in the entire country. It is relatively easy to cultivate from seeds or vegetatively and it grows on many types of soils, from clays to volcanic sands (ACTIBS 1989: 216).



Figure 58: *Mora de Castilla* berries Bogotá, Colombia.

The *Zarzamora* or *Morón* (*Rubus macrocarpus*) (Figure 59, Appendix B, Table 9) known in English as the giant Colombian blackberry, is endemic to the Colombian Andes and commonly found growing wild in the Muisca mountains. “It is native to a narrow, rather inaccessible zone in the higher areas of Colombia (2600-3400 m elevation)” (ACTIBS 1989:

216). Its color is lighter than the *mora de castilla*, but the plants and fruits resemble each other, with the exception that the *zarzamora* is very large. The giant Colombian blackberry is one of the biggest berries in the world. It is so large that is difficult to eat it in a single bite (ACTIBS 1989: 217). The flavor of this berry is very similar to the other *moras*, but because it is difficult to grow outside its natural region, it is almost impossible to market it outside of Colombia. Thus production is relatively small. These berries sell in the markets of Bogotá and Tunja for 3,500 Colombian pesos around 1.88 USD.



Figure 59: Zarzamora or moron berries (left). Size variation between the three species of *moras* largest *zarzamora*, medium size *mora de castilla*, small *mora silvestre* Bogotá, Colombia.

The *mora común*, also known as *mora silvestre* (*Robus adenotrichus*) (Figure 60, Appendix B, Table 9), is the smallest of this group. It grows wild in Cundinamarca and Boyaca and is not commonly commercialized because of its size and its sour flavor. “It is seldom cultivated, but the fruits of wild plants are collected and sold in the markets for the preparation of jellies, refreshments, and even wine” (ACTIBS 1989: 217). It is commonly found in pastures. When I was younger, I commonly ate these berries in the town of Yerbabuena, Cundinamarca where my neighbor had a cattle farm and you could find these berries. In the market of Paloquemao in Bogotá I was able to purchase these berries for 2,000 Colombian pesos per lb. around 1 USD. The merchant who sold me the berries mentioned that people bought them in

order to make a tea from the stems, leaves, and berries to treat fevers. These three species of blackberries and the Andean blueberry were of great importance for the diet of indigenous people of Cundinamarca and Boyaca and were especially important for the early inhabitants of this area, who depended almost completely on the collection of berries and other wild fruits that were eventually domesticated (Cárdenas-Arroyo 2001: 46).



Figure 60: *Mora Silvestre* plant and berries Bogotá, Colombia.

### Leafs

Some leafs of Muisca plants are currently used in the diet of modern South Americans. These include the leafs of the *achira*, *cubios*, *yuca*, *quinoa*, *ahuyama* and the *chachafruto*. They are eaten in salads and soups. However the most important leafs used in the Muisca diet were the coca leafs (*Erythroxylum coca*) and the *guasca* (*Galinsoga pawiflora*). The Muisca refer to eadible leafs as *Quysca*, *muin*, or *huazica* (Rozo 1998: 32). The majority of leafs used by the Muisca are no longer utilized for food because of the imposition of Western preferences for sweet foods as opposed to the bitter taste of the leafs used by the Muisca (Rozo 1998: 33).

### *Galinsoga pawiflora*: Guasca:

*Guascas* (Figure 61, Table 1) are one of the main ingredients of *ajiaco* and were adapted to this dish from its traditional Muisca use. The chronicler Oviedo describes the use of these



leafs as: “*y las guisan que se llaman guascas, bledos y muchas otras*” (1930: 56). According to this chronicler, the leafs of the *guascas* and many other plants were stewed. Colombia is possibly the only place in the world where this weed is used for food because this plant has small thorns on its leafs, which does not make it an ideal food product. It is exclusively used in the preparation of the traditional dish of Cundinamarca, the *ajiaco*. “It seems that this plant will thrive close to the potatoes fields of the Muisca and was considered a weed or a *guasca*. As nothing was wasted in these fields the plant was added to potato soups where its aromatic flavor was a great complement to the potatoes” (Diaz *et al.* 2008: 29). The accessibility to this plant allowed it to be used as one of the main ingredients of the *ajiaco*, a fusion of culinary techniques between indigenous and Spanish cooking, with an excellent flavor.



Figure 61: *Guasca* leafs a main ingredient of the traditional *ajiaco* Bogotá, Colombia.

#### *Erythroxylum coca*: Coca

Coca leaves (Table 1) were not used as a food product, but was part of the Muisca diet. These leaves were chewed in large quantities, being mixed with calcium obtained from

gastropod shells that were ground and placed in *poporos*. The *poporos* are containers made of different materials including gold, ceramic, stone, and wood where coca leafs were mixed with the calcium and then chewed to extract alkaloids, a process that reduced fatigue, altitude sickness, hunger, and pain (Figure 62). The Muisca traded salt for coca from groups at lower elevations where this leaf grew; they also cultivated their own coca at warmer valleys in Muisca territory and it was a desired plant by all the social classes for its religious and medicinal value (Kurella 1998: 198; Aguado 1956: 406). This plant is a woody shrub with brown stems. It has alternate leaves with an obobate shape (upside-down teardrop); it is dark green in color with a light grey underside and a smooth surface (Appendix B). The taste is bitter, similar to green tea. The smell is similar to hay and soil. Coca chewing had a ceremonial purpose for the Muisca, but was not exclusively destined to ceremonial rituals. According to the chronicles, the Muisca used coca regularly when conducting agricultural labor - to the point that the words in Chibcha for harvesting corn and chewing coca (*zeb chuscua*) were used interchangeably for both actions (Langebaek 1987: 79; Acosta Ortegón 1938: 42).

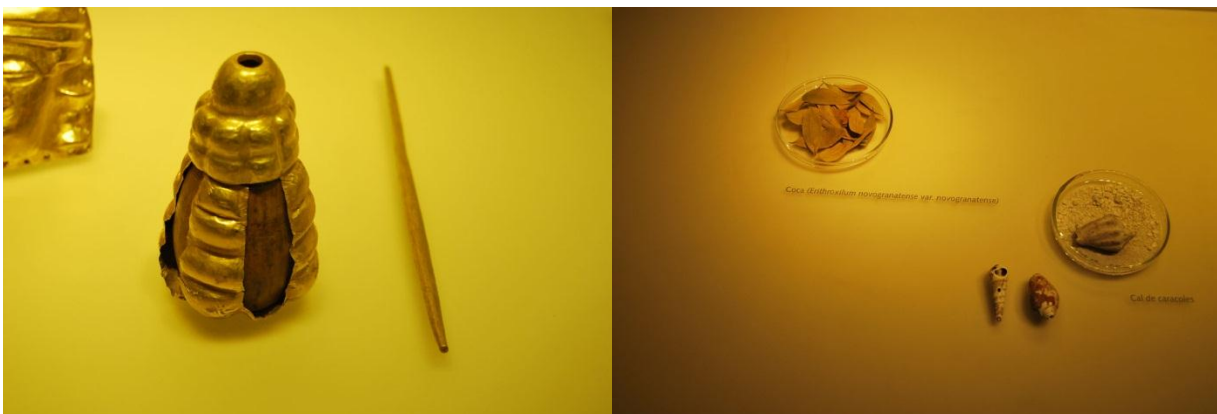


Figure 62: Gold Muisca *poporo* and stick for coca (left). Coca leaves and snails used for calcium (right) Museo del Oro Bogotá, Colombia.

Langebaek (1987: 79-81) dedicates an entire chapter to the use and cultivation of coca by the Muisca. According to this author, the Muisca cultivated the majority of coca in Soatá and Duitama, Boyaca and in the Chicamocha canyon. The inhabitants of the canyon traded coca for blankets and gold. An extensive internal trade network developed between the Muisca chiefdoms to transfer desired products, such as coca, gold, salt, and cotton blankets (Figure 63). The Chicamocha canyon was the preferred zone to grow coca because this plant tolerates dry environments and it was possible to obtain two harvests a year in this location. Other areas utilized to grow coca in Muisca territory were Guatavita and Fomenque, Cundinamarca where the majority of the production was destined to trade. According to Aguado (1956: 406) “in order to get coca the Muisca will go wherever it was produced and trade one load for two blankets and after the load was brought to the markets in Tunja it was traded for four blankets”. As shown by the last description, coca (Figure 64) was a highly valued product by the Muisca and continues to be of extreme importance for contemporary indigenous societies in Colombia like the Kogui of the Sierra Nevada de Santa Marta, demonstrating the continuation and importance of this plant outside its criminalized use in the production of cocaine in the country.



Figure 63: Map created by the author showing the trade of coca leaves within the Muisca territory before and during the conquest, based on information found in Langebaek (1987).



Figure 64: Coca leafs and coca plant Bogotá, Colombia

### Fauna

It has been suggested that the Muisca diet contained little animal protein (Labbé 1986: 154; Kurella 1998: 199). It is certain that the Muisca diet was mostly based on agricultural products, as demonstrated in stable isotope analysis of human remains (*see* Cárdenas-Arroyo), but animal protein had an extremely important role in the diet of all the social classes in the chiefdom. The consumption of certain types of foods was indeed restricted to the elites - as was the case for the majority of the corn and deer that was rarely distributed to the lower strata (only during feasts and communal work efforts). Hunting was a common practice of the Muisca (Simón 1981 [1625] III: 164) and the chronicles also support the idea that the consumption of meat was restricted to the chiefly class (Visita (1560) 1988: 75). It has been suggested that hunting was done by large groups of people. Spears, slings, arrows, tramps, and blow guns were the methods preferred for this activity (Viricoechea 1871: 128). It appears that the richest hunting grounds were uninhabited locations in the cold valleys and *paramos* that the hunters

patrolled in search of deer, rabbits, tapirs, mountain lions and guinea pigs destined to food, trade, and tribute (Langebaek 1987: 71).

The restriction of meat used by the lower classes probably referred specifically to deer and other large game animals, but does not mean that the lower social classes only ate plant agricultural products for they had at their disposal an extensive diversity of animal species within their territory (Rozo 1998: 29). This is especially true for people in remote locations and those dedicated to hunting and raising animals. The change of elevations in this part of the Andes contains a wide range of microclimates with a rich biodiversity of animals. The Muisca had access to a wide variety of fish and fresh water species as well as a variety of birds and mammals (Table 2, Table 3), that could hunt for food. In their homes they raised the domesticated guinea pigs and these animals provided meat to all social classes, not only the elite. It is common to find higher proportions of *Cava* bones than any other animal, including deer, in Muisca sites, an indication that guinea pig consumption was widespread among the Muisca population (Ijzereet 1978: 170). It was likely that the range in the consumption of animal protein was not only due to social constraints but was also influenced by many factors, including geographical position, occupation, and accessibility. It is possible to define what species of animals were used for food by the Muisca as there is extensive archaeological evidence that animal remains were processed for consumption, as well as detailed descriptions of animals that were eaten and offered to the Spanish during the conquest. There are also representations of animals in the Muisca iconography found in their gold artifacts, ceramics, and stone tools.

## Mammals

### Cavia porcellus: Guinea pig

The guinea pig was the only domesticated animal species of the Muisca. The constant hunting of wild guinea pigs in the region led to its domestication during the Herrera period (Langebaek 1987: 70). There are still wild varieties of guinea pigs that continue to be hunted near the site of Herrera. These are possibly the ancestors of the domesticated animals the Muisca raised and that we find today in this territory (Broadbent 1971: 173). In the Chibcha language this animal was referred to as *fuquy* or *fucos*; the action for trapping the guinea pig was called *chihibago* (Correal and Pinto 1983: 75). The consumption of *Cavia* by the people inhabiting Cundinamarca and Boyaca dates to the pre-ceramic period. The domestication of this animal was only possible after thousands of years of experimentation and through the opportunistic hunting and capture of the animals, especially in nearby gardens planted with species that attracted them (Cárdenas-Arroyo 2002: 22).

There is extensive evidence of guinea pig (Table 2, Table 3) consumption throughout all the periods of occupation in the Bogotá Sabana and Tunja and there are no indications of restrictions in the consumption of this animal (Pradilla *et al.* 2005). This fact contradicts the idea that the Muisca had limited access to animal protein. The results of isotope analysis, indicating the lack of animal protein in human diet, do not take into consideration the similarity of this animal's diet to that of humans, possibly leading to inaccurate results. In the site of Checua, Cundinamarca there is evidence of guinea pig consumption, including bone evidence and tools used for butchering dating to *cal* 7400BC-*cal* 6440 BC (8200± 110 BP – 7800 BP± 160 BP), demonstrating the early manipulation of this species in the region (Groot 1995: 54). Other early

pre-ceramic evidence of guinea pig consumption in the Bogotá Sabana comes from Petroalto (*cal* 7400 BC – *cal* 6440 BC), and Soacha (915 +/- BP – 720 +/- BP) (Cárdenas-Arroyo 2002: 30-31). Stable isotope analysis of human bone at the sites of El Abra and Tequendama, Cundinamarca indicate that the consumption of meat from deer and guinea pig increased gradually, especially for *Cavia*. There are more bones from the rodent than from deer at these sites starting from 7,000 BP (Ijzereet 1978; Correal and van der Hammen 1977). The domestication of guinea pig in the Bogotá Sabana took place after 2,500 BP and it is demonstrated by the morphological changes of the pelvic bones (Figure 65) of *Cavia* samples obtained from the site of El Abra. These changes are easily noticeable when compared to wild varieties of this species (Ijzereet 1978: 170).



Figure 65: Domestic guinea pig pelvic bones recovered at La Muela, Tunja by the UPTC, Colombia.

The early domestication of guinea pig allowed the human populations of the region to have a more controlled and stable supply of animal protein. Thus adaptation was so successful that the habit of raising guinea pigs for consumption is still practiced today in various regions in Colombia, including Cundinamarca, Boyaca, Huila and Nariño. It is common knowledge that these rodents are extremely fertile from three months to seven years of age and can have new offspring every 65 days (Correal and Pinto 1983: 75). In the town of Saucio, Cundinamarca the



local farmers value the meat from these rodents so much that they keep them in their houses to fatten them, in order to eat them and sell them in the local markets (Langebaek 1987: 70). These guinea pigs are fed human table scraps and parts of the plants not used for human consumption, including the husk of the corn and the pods of the beans. This practice is very interesting because the human diet resembles the diet of the guinea pig in terms of the food products utilized and these methods were possibly also practiced by the Muisca and their ancestors.

Domesticated guinea pigs are dependent scavengers and roam around their host's house in search of human table scraps. Their diet is generally similar to the humans that raise them. Stable isotope analysis of human and guinea pig bones from the Wari site of Conchopata, Peru indicate that the diets of *Cavia* and humans were very similar with the exception of nitrogen values, which are higher in the human diet, an indication of the consumption of animal protein and corn (Finucane *et al.* 2005: 1-10). The guinea pigs of Conchopata had a variable presence of corn in their diet, indicative of the differential consumption of maize by the humans that raised them, possibly related to social stratification or the form in which corn was acquired in each household (2005: 8). If corn was not processed, the guinea pig in that household would have had more access to a C4 diet as it could eat the corn husk. In households where processed corn was obtained in the form of grains, this limited the amount of corn available to the guinea pigs. It is not known how the Muisca raised their guinea pigs, but it is likely that they used the same technique of having the animals in their household eating table scraps from the floor, as was done by the Wari and by the modern human population in Cundinamarca. A stable isotope analysis of Muisca guinea pig remains would allow us to determine what type of diet they had and how these animals were raised by the Muisca. An analysis of samples from the large number

of preserved guinea pig bones recovered at the site of La Muela, Tunja would be ideal for this type of project (Table 3).

Excavations by the UPTC in the Muisca site of La Muela, Tunja has led to the recovery of 503 bone remains belonging to *Cavia* (Pradilla *et al.* 2005). It is interesting that these fragile bones are so well preserved, even better preserved than those from deer. After visual inspections of these bones, it is possible to assume that they contain enough collagen to conduct a successful stable isotope analysis, although a collagen test would be the preferable technique (Figures 66, 67, 68). From the samples acquired at the UPTC it was possible to identify 9 samples of completely domesticated animals and 16 transitional samples. The majority of the bones recovered from this sample came from human burials, indicating that these animals were placed there as food offerings. The majority of the bone samples show that the animals were large and developed, coming from individuals which had reached adulthood and been killed at a selected age. This way to reducing the amount of food and time required to raise them an indication these were domesticated. The preservation of these bones is outstanding. It can easily be determined what part of the animal each bone belongs to as well as identify indications of human consumption caused by burning and cut marks (Figures 66, 67, 68). The chronicler Oviedo (1852: 407) mentions that the Muisca: “have innumerable quantities of guinea pigs that they eat as many times as they want to”. These animals were consumed by a large part of the population, as they were easily raised and in large numbers. The high amount of guinea pig bones in Muisca and pre-Muisca sites indicate that consumption of these animals did not have restrictions for the population, as was the case for deer.



Figure 66: Domestic guinea pig mandibles recovered at La Muela, Tunja by the UPTC



Figure 67: Domestic guinea pig femurs (left). Domestic guinea pig humerus notice burned areas indication of cooking. La Muela Tunja, Colombia UPTC.

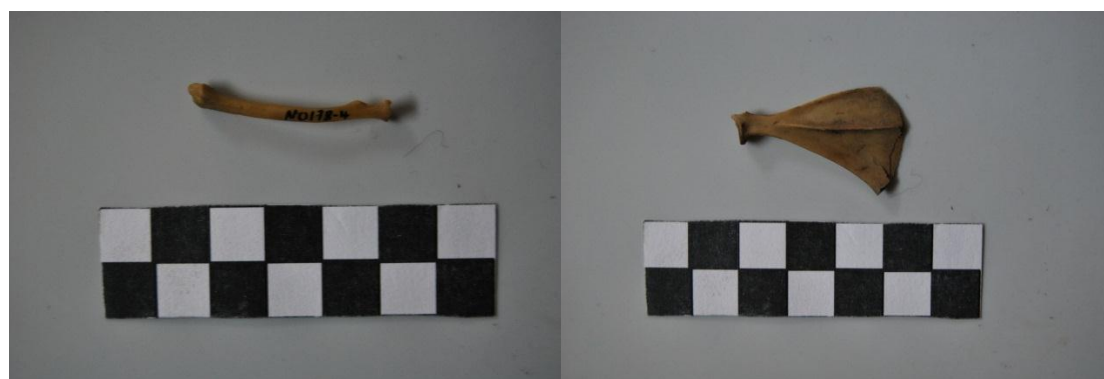


Figure 68: Domestic guinea pig radius (left). Domestic guinea pig scapula (right). La Muela Tunja, Colombia UPTC.

Odocoileus virginianus, Mazama rufina, M. Americana, M. goazoubira: Deer

It is not known if the deer hunted and eaten by the Muisca were wild or semi-domesticated. I refer to semi-domestication as controlled populations which were not afraid of humans, were fed by humans, and in some cases were corralled, similar to the reindeer herds of North America and Siberia that are neither wild nor completely domesticated. Simón (1981 [1625]) noted that deer roamed freely in Muisca territory and were so numerous that they resembled the cattle and sheep of Spain. As described in the chronicles, the Muisca offered the deer to the Spanish in large quantities apparently to distract them from advancing deeper into their territory; about 80 deer were killed daily as offerings for the Europeans (Simón 1981 [1625] IV: 397). The comparison made in the Spanish chronicles between their domesticated herds of sheep and cattle and the deer of the Muisca is very interesting. The evidence for corrals in Muisca chiefdoms supports the idea of semi-domesticated or controlled populations of deer (Tovar 1980: 22). The manipulation of deer by the Muisca was described as: “Las carnes que comen los indios en aquesta tierra son venados de que hay infinidad, en tanta abundancia que los basta a mantener como aca los ganados” (The meats that the indians eat in this lands are those of deer which exist in such abundance that they are maintained as here (Spain) is cattle) (*Descripción de la Ciudad de Tunja* 1943 [1610]: 430). Simón (1981 [1625] IV: 397) states that deer roamed in “manadas como si fueran ovejas...” (herds like they were sheep). Deer are also represented in Muisca iconography, an indication of the importance of this animal for the chiefdoms (Figure 69).



Figure 69: Gold deer figurine from the Late Muisca Period Museo del Oro Bogotá, Colombia.

Considering the descriptions of the Spanish, it appears as though the deer were semi-domesticated or at least controlled and protected. To establish this scientifically, a stable isotope analysis of deer bone found in Muisca sites would be crucial. If the deer remains contain a high concentration of C3, it would indicate that deer consumed mainly tree foliage and were possibly completely wild. If the concentration is of C4, then the deer consumed corn, perhaps indicating they were semi-domesticated, as described in the chronicles, although it could also suggest that deer had unwanted access to corn crops. Emery (2000) conducted this type of research in the Maya area and determined that, although the deer bone exhibit a high concentration of C4, the deer were not semi-domesticated. The high consumption of corn by these animals was due to the large number of corn fields in the area that allowed the deer to enter the fields to feed on the corn. This might also explain high C4 levels within Muisca deer populations. Cárdenas-Arroyo (2002) tried to conduct stable isotope analysis of deer bone of the Muisca at Bacata (Bogotá), but he only tested one sample and did not obtain any valid results (it is possible this sample did not contained enough collagen to conduct chemical analysis of isotopes.) These types of studies are lacking in Colombian archaeological studies and this kind of research is crucial for our understanding of complex Pre-Columbian societies from the Colombian Andes, especially concerning their dietary practices.

Consumption of deer was the most important determinant of the Muisca restrictive diet, as it was only eaten and hunted by the chiefly classes - with the exception of feasts and important occasions where the entire population was allowed to eat it. Deer remains (Figures 70, 71) found in some of the complex human burials at Los Altos Santuarios and La Muela indicate that these human individuals were part of the chiefly social classes. In an attempt to determine the control

or semi-domestication of Muisca deer, I measured, described, and collected samples from deer femurs found in complex and simple burials at Los Altos Santuarios and La Muela recovered by the UPTC (Table 3). This was done for a future analysis of the Carbon isotopes of the osteological material at these Muisca sites, hopefully showing through ratios of C3 and C4 if these were wild or controlled animals. I collected 1 to 3g of deer femur bone material to test for content of collagen in the U.S. with the assistance of Dr. Dupras of the University of Central Florida. In order to conduct stable isotope analysis 20 to 40 mg of bone powder is required (Dupras, 2001). I collected 1 to 3g to have extra material as a precaution (this will be part of a future project). Bone collagen quality of human and faunal bone from Los Altos Santuarios and La Muela will be tested by using the methods mentioned by Van Klinken (1999). I choose to collect femur samples (Figure 70) as this is the most reliable bone to use for stable isotope analysis (Dupras, personal communication 2008).



Figure 70: *Odocoileus virginianus* femur samples collected for collagen testing from La Muela Tunja, Colombia recovered by the UPTC.



Figure 71: *Odocoileus virginianus* maxilla (left). Deer antler (right). Recovered at La Muela Tunja, Colombia by the UPTC.

#### Other Mammals:

In addition to deer and guinea pig, the Muisca hunted other wild mammals for consumption as well as for pelts and skins. Excavations at the UPTC recovered mammals that included: dogs, *Canis* (but it is not clear if it was a domesticated animal); armadillos, *Dasypus kappleri*; coati, *Nusuela olivacea*; foxes, *Cerdocyn thous* (Figure 72), and *vulpes*; opossum, *Didelphis marsupialis*; puma, *Felis oncolor*; and rodents, including the agouti, *Agouti taczanowski*, cotton rat, *Sigmodon sp*, and rabbits, *Sylvilagus brasiliensis* (Pradilla *et al.* 2005) (Table 2, Table 3). The majority of these animals were destined for human consumption and possibly part of the Muisca diet. In addition to the previous animals mentioned, the chronicler Zamora (1980 [1701]: 144-159) described the presence of *zaino Tayassu tajacu*, wild pigs, otters, and monkeys. Langebaek (1987: 7) adds that archaeological excavations of Muisca sites show the presence and consumption of: an endemic mouse *Sigmondus bogotensis*, rabbits *Sylvilagua sp*, peccary *Tayassu pecari*, and weasels *Mustela sp*. It is curious that the only mammals recognized in the iconography of the Muisca and Herrera societies are the monkeys, deer, and felines (Legast 1995: 10). These mammals just described had the potential for mass



consumption and there are no indications for restrictions regulating their consumption with the exception of deer (Rozo 1998: 29). The meats of these animals, as well as of the guinea pig and deer, was either cooked fresh or smoked and added to the Muisca *mutes*, soups, stews, and possibly other unknown dishes (Rozo 1998: 63).



Figure 72: Fox mandible recovered at La Muela Tunja, Colombia by the UPTC

### Birds

Colombia has the largest number of species of birds in the world (n=1,871) and the Muisca had an abundance of species in their territory that were hunted and possibly raised for food. Spanish colonial documents mention that the Muisca raised birds in large quantities for consumption, although it is not known if this was an introduced practice by the Spanish or a native custom; the documents also describe the use of Cornish hens, doves, and ducks (Tovar 1988: 77). It is very possible that the Muisca did raise and control some species of birds for consumption, just as they did with some mammals and fish species before the conquest. Zamora (1980 [1701]: 144-159) described the consumption by the Muisca of ducks, doves, Cornish hens, and wild hens but their specific species are not known. Some endemic species in the *humedales* of the Bogotá



Sabana at this point are endangered and could be some of the ones mentioned in the chronicles. These include: the *Podiceps andinus*, a type of water bird similar to the anhinga, ducks, like the *Oxyura dominica*, *Dendrocyna autumnalis*, *Oxyura jamaicensi*, *Anas gergica*, *Anas cyanoptera*, and *Netta erythrophthalma*, the American purple gallinule, *Porphyrio martinica*, another almost extinct endemic gallinule, the *Gallinula melanops*, some parrots, like the *Ognorhynchus icteriotis*, and the *Gallinago undulate*, a wild hen the *Odontophorus strophium*, and the dove *Zeanaida articulata* (Boada 2006: 24).

In addition to these endemic species, it is also possible to determine other birds encountered by the Muisca found in the iconography (Figure 73). Muisca gold ornaments depicting birds are common and sometimes the detail in the craftsmanship of these figures allows for the identification of a specific species. Large birds highly desired for their quality meat, including the native crested guan *Penelope purpurascens* and the Andean guan *Penelope montagnii*, are clearly represented in gold artifacts (Legast 1995: 19).

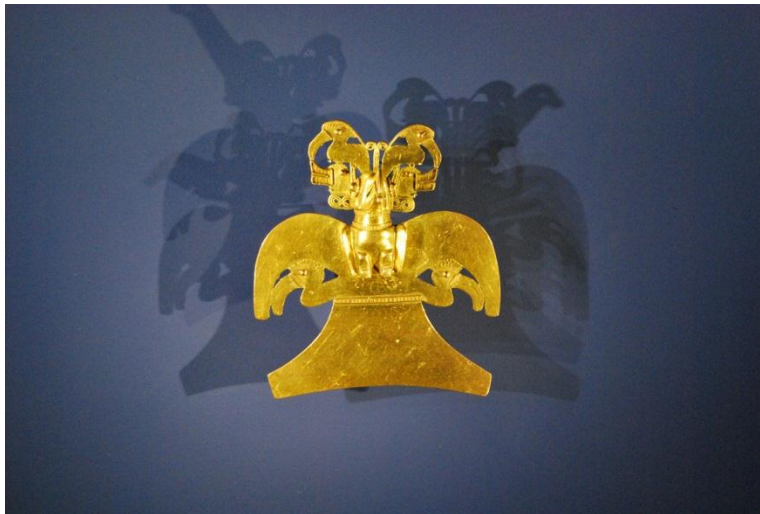


Figure 73: Gold ornament of a large bird, Late Muisca period Museo del Oro Bogotá, Colombia.

Most likely the Muisca hunted the guan, but the fragility of their bones has not permitted their archaeological identification. Excavations at the site of La Muela by the UPTC led to the recovery of preserved bird bones of multiple species, the majority found in burials. The bird bones are distributed throughout the site, although the identification of specific species has not been undertaken and the UPTC is expecting a future research project by a specialist to identify these bones. It was possible to determine that the bones belong to at least seven different species, four of them large birds, possibly guans (Pradilla *et all* 2005). It is clear the Muisca hunted and possibly raised birds for their meat and these were part of the Muisca diet, as the ethnohistory and archaeology of the region suggests.

### Fish

Fishing was an important activity for the Muisca and their territory had a rich variety and quantity of fish used for sustenance. According to the conquistador Jiménez de Quesada (1962 [1545]: 295) there were abundant fish in the rivers of Cundinamarca and Boyaca. The Muisca probably practiced pisciculture in the ditches between the *camellones*, where the fish known as capitán *Eremophilus mutisii* a species of catfish, was raised for human consumption (Broadbent 1987: 435). The possibility of the practice of pisciculture by the Muisca is likely. There is archaeological evidence of heavy fishing weights (Figure 74) that were used with nets to capture large quantities of fish, as well as descriptions of this practice in early Spanish documents. Some of these fishing weights inspected at the Museo del Oro in Bogotá are spherical 8.5 cm in diameter with a weight of 800g made with granite; others are made of stone usually rounded at the edges with a larger flat surface areas weighing more than 1 Kg each. This is an indication that they were used for relatively large fishing nets. Even if pisciculture was not practiced, the

large fishing weights demonstrate that the Muisca used advanced fishing techniques to capture large quantities of fish from rivers and lagoons in their territory. Some of these fishing weights have been recovered in the Muisca sites of Fúquene, Sogamoso, and Soacha, Cundinamarca but the chronology of these artifacts is unknown (Langebaek 1987: 72).



Figure 74: Fishing weights of the Muisca period Museo del Oro Bogotá, Colombia.

Fishing was an important activity in the main bodies of water found in Muisca territory including the Fúneque lagoon, Cundinamarca, and the Tota lagoon, Boyaca (Langebaek 1987: 72-73). One of the main locations for fishing was the Bogotá River that crosses the entire Sabana and its tributaries. The Bogotá River is 72 km long and approximately 2m deep (Boada 2006: 23). The river was commonly used by the Muisca for fishing and transportation, but is so highly polluted today by sewer runoff from the city that these activities are no longer possible. The chronicles mentioned that the most important resource of this river was the capitán fish *Eremophilus mutisii* and that the Muisca had controlled areas bounded by nets for raising this fish. The capitán fish did not have scales and was compared to the eel, which was eaten in Spain (Tovar 1988: 77). This species of catfish endemic to the Bogotá Sabana was called *chichinegua* in the Chibcha language of the Muisca. The word for fishing was *chupcua*, very similar to the

word *chucua* that refers to the *camellones*, an indication that the capitán fish was nourished in the canals between the raised fields, as suggested by Broadbent (1987: 435).

It has also been suggested in the chronicles that fishing was not a very productive practice, but that the quality of the fish was so high that it was still a primary activity by the Muisca “The fish that they raise in that kingdom although is not abundant it is the best of them all, because of its particular flavor, it is of only one kind and not too big about the size of a hand or two but is an admirable thing to eat” (Jiménez de Quesada 1962 [1545]: 295-296). “There is no fish in Tunja and in Bogotá there is a fish that lives in that river although not too big is extremely tasty and good” (Oviedo 1852: 407). This is contradicted by Zamora (1980 [1701]: 152) who explains that fish was abundant in Bosa and Madrid, Cundinamarca and was commonly fished by the Muisca. It is likely these fishes were roasted, steamed, or fried as it is done in areas where capitán fish is still found (Rozo 1998: 64). Some of the catch of capitán fish was destined for tribute to the caciques of Bogotá and Sogamoso and was also traded for other foods and cotton blankets (Langebaek 1987: 73). Unfortunately, overfishing of *Eremophilus mutisii* and the pollution of the Bogotá River and its tributaries has deteriorated the ecological niches of this fish and has almost led to this extinction.

The majority of the evidence for fishing practices by the Muisca comes from ethnohistoric evidence, as archaeological evidence of this type is mainly based on the fishing weights mentioned earlier. The fragility of fish remains has not permitted archaeologists to successfully recover fish bones associated with Muisca sites, with the exception of a few fragments from the site of Zipacón, Cundinamarca with an associated date of 1320 BP; their poor preservation did not allow for an identification of the species (Correal and Pinto 1983: 89). The Muisca also represented fish in the iconography, especially in gold objects. *Eremophilus mutisii* was

commonly represented in gold figures identified easily by its iconic barbells (Figure 75); some of these are currently exhibited at the Museo del Oro in Bogotá. Other representations of fish in Muisca artifacts include those of the genera *Astroblepus* that are native to creeks in the mountains in Cundinamarca and from the genera *Chaetotoma*; both are valued for their exquisite flavor, often compared with that of the lobster (Legast 1995: 51). Although the archaeological material related to fishing is relatively limited, the ethnohistoric accounts of the practice of pisciculture is extensive showing the highly evolved techniques used by the Muisca for nourishing fish in the canals located beside their raised fields. The grammatical similarities between the names for fishing and the names of the raised fields themselves also suggest that this practice did occur. The evidence of large fishing weights is another indication of specialized fishing practices used in pisciculture. In addition to this evidence, it is known that farming communities in Boyaca and Cundinamarca make canals next to rivers and lagoons in order to detour the passing fish from the river into these canals, thereby retaining a large number of them that eventually be eaten, following a practice very similar to a Muisca method mentioned in the ethnohistory (Langebaek 1987: 72).

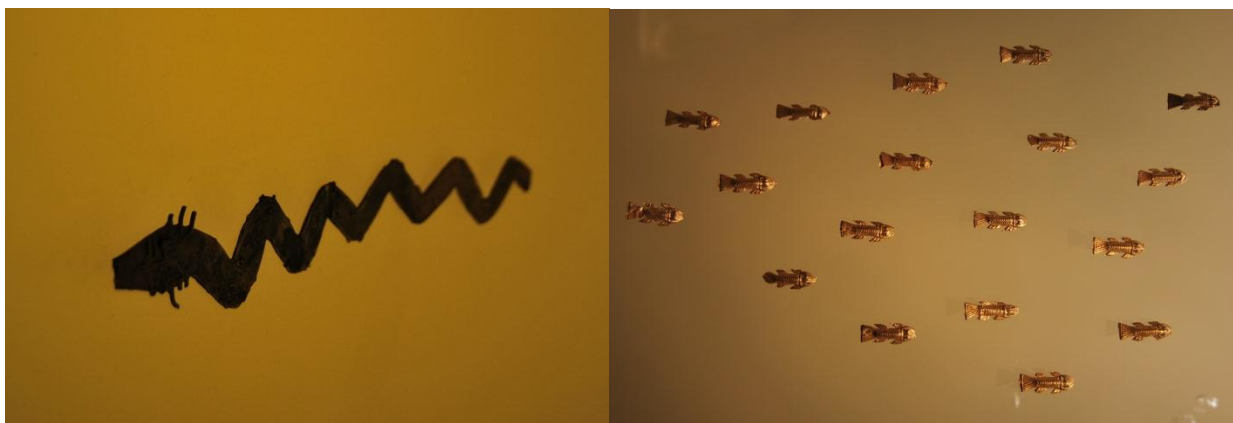


Figure 75: Gold ornament of a capitán fish, the eel like cat fish is easily recognized for its barbells (left). Small gold fish from a Muisca necklace. Museo del Oro Bogotá, Colombia.

## Muisca Artifacts Used for Processing, Service, Preparation, and Storage of Food Products

Utilitarian materials used for the preparation, cultivation and serving of food products recovered after excavations of Muisca sites facilitates our understanding of the dietary practices of this society. For these purposes the Muisca used a wide array of materials that included stone tools, ceramics, bone, wood, animal skins and other perishable materials. In this section I will describe some of the non-perishable materials left by the Muisca in terms of their function. This description will be based on artifacts analyzed at the Ceramic and Stone tools Deposit in the Museo del Oro in Bogotá (Table 4) and on artifacts recovered at excavations in the city of Tunja by the UPTC.

### Ceramics

Muisca ceramics (*see* Appendix D for scale drawings of Muisca ceramics) are relatively scarce. There are approximately 950 intact vessels included in the collections at the Museo del Oro, Museo Nacional, and Museo del Banco Popular (Labbé 1986: 157). In comparison to the restrictions found in food products and gold regalia, the circulation and ownership of foreign ceramics was not an indication of status or restricted (Patiño 2003: 140). The majority of these imported ceramics are bowls, jars, *ollas*, and cups - all used for serving foods. During the Early and Late Muisca periods, these types of ceramics were used for food service during feasts associated with the trade and redistribution of excess production for the cacique in exchange for future services and tribute (Langebaek 1995: 173; Patiño 2003: 142). Another trade item was a type of ceramic used in the evaporation and trade of salt (Cardale 1981: 150), an important element in the Muisca diet. It is clear that the production and trade of ceramics was mainly

directed towards the storage, preparation, and service of foods and not primarily for ceremonial functions. The specialization of Muisca ceramics was not complex; the majority of this material was not produced by specialists exclusively dedicated to this profession except in the town of Raquira, Boyaca, known during the conquest for its pottery and still producing high quality ceramics today (Figure 76) (Rojas 1977: 17).



Figure 76: Modern town of Raquira well known for its ceramics since Muisca occupation.

Muisca jars (Figure 77) were used for transporting, containing, and serving liquids (Patiño 2003: 147), including water and *chicha* as described in the chronicles (Rojas 1977: 22). These usually have globular wide and short bodies with restricted rims and were rarely decorated or elaborate. Another type of elaborate jars known as *mucuras* (Figure 78), are described as pitchers with a globular body and long neck with attenuated spouts and flaring shoulders, usually modeled into a human face with painted decorations of geometrical figures restricted to the shoulders and spout (Labbé 1986: 157).





Figure 77: Muisca jar (left). Muisca *mucura* (right). Museo del Oro Bogotá, Colombia.



Figure 78: Muisca jar *Guatavita desgrasante mucura*, notice the geometrical figures. Museo del Oro Bogotá, Colombia.

The *mucuras* with their anthropomorphic and zoomorphic motifs were also used for serving and storing liquids, as well as offerings of chicha found at burials (Rojas 1977: 22). These fine jars had a direct religious purpose and were used during celebratory feasts and weddings (Salge 2007: 77; Rojas 1977: 23). The faces usually represented in this form of pottery might show Bachue, the mother of mankind according to Muisca religion (Labbé 1986: 157). These vessels were clearly the most elaborate form of pottery made and proliferated during the Late Muisca period, an indication of an increase in religious practices possibly associated with



an increase in the population (Langebaek 1995: 117). Another type of ceramic vessel used for ritual and food consumption are cups (Patiño 2003: 142). Pedestaled cups (Figure 79) were also elaborate ceramics decorated on the outside during the Early Muisca period and also on the inside during the Late Muisca period (Langebaek 1995: 117). These were used for drinking *chicha* during feasts, as well as for funerary offerings and collect blood from the Moxas, a name given to children destined to become religious sacrifices (Rojas 1977: 31).



Figure 79: Pedestal cup dating to the Muisca Period painted outside and inside *Guatavita Desgrasante*. Museo del Oro Bogotá, Colombia.

*Cuencos* or bowls (Figure 80) were the main utensil for serving foods and drinks. These were utilized during feasts for this purpose (Patiño 2003: 142). *Ollas* were used for storage, for fermenting corn, and for cooking. These have globular bodies, short necks with inverted rims and rounded lips, and sometimes handles. Some *ollas* are decorated and painted, usually with geometrical shapes and modeled with zoomorphic and anthropomorphic figures. They usually have burn marks evidence of their function for cooking (Rojas 1977: 31). Other smaller versions of this type of ceramic, called *ollas cuenco*, were used for storing foods; these did not have handles (Patiño 2003: 147). There are a wide variety of sizes and styles of *ollas*; this form is the most abundant type of ceramics (Figure 81). There were also ceramics used for the evaporation of salt, known as *guachas* (Figure 82) (Patiño 2003: 141).



Figure 80: Muisca *cuencos* used for serving food and drinks. Museo del Oro, Bogotá.



Figure 81: Muisca *ollas* of different shapes and styles sometimes decorated and painted (left). *Ollas cuenco* (right). Museo del Oro Bogotá, Colombia.



Figure 82: *Guacha* a type of ceramic used in the evaporation of salt. Museo de Oro Bogotá, Colombia.

## Stone tools and Bone Tools

The Muisca used chert, granite, jasper, and other stones as materials for tools used in the acquisition, preparation, and processing of foods (Table 4). Stone tools (*see* Appendix D for scale drawings of Muisca stone tools) were essential materials that allowed the Muisca to exploit food products more efficiently and, like ceramics, should be considered part of the development on the dietary practices of this society. Manos and metates (Figure 83) are usually found incomplete and broken, usually made of granite. These are ground stones used for processing corn for the preparation of *bollos* and *arepas*. Large axes (Figure 84) made of stone were used mainly for agricultural purposes, especially for cutting and digging ditches (Langebaek 1987: 53). Smaller stone and granite axes (Figure 84) were used for cutting and hammering all kinds of materials, including vegetable and animal products. Mortars and pestles, sometimes carved into anthropomorphic and zoomorphic figures (Figure 85), were used for grinding spices and foods. Sharpeners (Figure 86) made of different stones are also common for Muisca stone tools and used on axes and chert tools (Pradilla *et al* 2005). The Muisca used chert points for their arrows and spears as well as stone-tipped atlatls for hunting (Figure 86). Large perforated stone and granite fishing weights were another type of stone tools artifact related to food acquisition (Figure 87). In addition to the stone tools, bone tools (Figure 87), including deer antlers, were used for puncturing, mixing, and cutting food products. Other perishable materials used by the Muisca for food processing were animal skins for transporting liquids. Wood tools were used for multiple functions such as mixing soups, *chicha*, and other food products; wooden rods used in agriculture (Langebaek 1987: 53). These tools facilitated the cultivation and the collection and consumption of the food products mentioned earlier in this text, allowing the Muisca to conduct these activities more efficiently.



Figure 83: Muisca stone mano and granite metate Museo del Oro Bogotá, Colombia



Figure 84: Muisca stone axes large and small. Museo del Oro Bogotá, Colombia.



Figure 85: Muisca stone mortar and bird carved pestle. Museo del Oro Bogotá, Colombia.





Figure 86: Stone sharpener (left). Jasper Atlatl (right). Museo del Oro Bogotá, Colombia.



Figure 87: Muisca granite fishing weight Museo del Oro Bogotá, Colombia (right). Deer bone tools for puncturing, mixing and other functions UPTC Tunja, Colombia.

## **CHAPTER SIX: LIMITATIONS OF RESEARCH**

Five outstanding limitations can be noted for the research undertaken here:

1. There is a lack of archaeological research in this area and, if we take into consideration the material remains left by the Muisca, these do not represent the complexity of this society as described in the Spanish chronicles (Reichel Dolmatoff 1965).
2. Although fish consumption was probably an important contribution to the protein supply of the Muisca (Jiménez de Quesada 1972 [1545]), there are only a few archaeological remains that represent this consumption. These include a few fishing weights and fish bones described earlier in this text. This is problematic, as the Muisca probably practiced pisciculture in the ditches between raised fields and water sources (Kurella 1995: 199). The lack of this information hinders a total comprehensive reconstruction of the Muisca diet, until we are able to understand what was the role and importance of fish consumption for this culture.
3. There is not only a lack of published sources on the Muisca diet, but most are written in Spanish and required translation by the author. This is most problematic in the case of the primary sources and the chronicles, as these are written in Old and Colonial Spanish, which is difficult to understand even for a native speaker. The chronicles use common names for certain plants and animals that might not be currently in use, thus posing a challenge to accurate species classification.
4. The Colombian Andes have a highly acidic soil which causes the deterioration of organic materials. An example of this is the problems encountered in the site of San Agustín, where the majority of human, animal, and plant remains have been completely decomposed due to the acidity of the soil (Duque Gomez and Cubillos, 1988: 82). Kurella

(1998) also describes that, due to the acidity of the soil in the Andes, Muisca perishable organic materials, such as blankets and wood, have not survived to the present.

5. Looting has been one of the biggest problems for Colombian archaeology. This practice is still glorified in the country and there is also a lack of authority to deal with looting. Laws allow land owners to keep any type of archaeological material they encounter on their property. Most artifacts in museums, especially gold objects, are out of context as they were mainly recovered by looters and not by professional archeologists (Agudelo 2007; Calles 2007).

## **CHAPTER SEVEN: CONCLUSION AND IMPLICATIONS**

The reconstruction of the Muisca diet is possible through an interdisciplinary approach. The evaluation and identification of archaeological, ethnobotanical, and ethnohistoric evidence of Muisca practices facilitates the identification of their food products, their preparation, and the methods of acquisition and consumption. Multiple archaeological investigations of Muisca sites focus on food identification methods that include: the analysis of human food remains, and tools to process foods; the iconography of artifacts depicting foods; pollen analysis; phytoliths; dental wear patterns; and stable isotope analysis, all fundamental tools to determine ancient diets. The archaeological evidence is supported by ethnobotanical studies of the modern uses of Muisca products through cross-cultural comparisons between ancient and modern societies. The written descriptions of Muisca dietary practices left by the Spanish during the conquest allows us to have an insight on the food products of the Muisca and how these were used. This is especially important as we lack the ability to see these practices first-hand and ethnohistoric evidence is sometimes the only evidence we have on the utilization of these products.

The evidence collected in this thesis demonstrates that the Muisca utilized at least forty-two species of plants in their diet and approximately twenty-three of these species were domesticated either independently or through cross-cultural adaptations (Table 1). The Muisca diet also included at least seven species of mammals (Table 2), three species of fish and twenty species of birds. It appears that the Muisca only domesticated one species of animal, the guinea pig, although some species of mammals such as deer, a species of cat fish, and a variety of birds were controlled and raised for consumption by this society. This research also demonstrates that the microverticality technique used by the Muisca allowed this society to exploit a great variety of food products. The cultivation and collection of tubers, grains, legumes, and fruits of plants



with different environmental requirements was only possible with the efficient utilization of the thermic floors found in this part of the Andes. The variety of climates and elevations also resulted in an abundant biodiversity of animals that the Muisca and the early inhabitants of the region hunted for food. Another essential agricultural technique practiced by the Muisca was the utilization of raised fields known in the region as *camellones*.

*Camellones* are artificially elevated surfaces that allow the roots of the crops to be drained and reduce humidity (Boada 2002: 83). This strategy permitted the farmers to prevent frost, and reduce the effects of droughts and floods minimizing crop failure. The use of *camellones* created favorable conditions for corn cultivation, and with this agricultural method, the Muisca were able to produce two corn harvests per year, increasing the productivity of the land. Most likely, the *camellones* were utilized for growing multiple crops on the same field and not monocropping, as the early Spanish sources suggest. It is possible that the *camellones* were used to grow corn, beans, and squash, as each of these species benefits from each other when growing side by side an agricultural strategy supported by pollen analysis in Muisca agricultural fields (Boada 2002). In addition to agricultural products, the *camellones* were also utilized to raise fish and the Muisca possibly practiced pisciculture in the ditches between the *camellones*, where the fish known as capitán *Eremophilus mutisii* a species of catfish, was raised for human consumption (Broadbent 1987: 435).

The impressive number of food products used by these chiefdoms and their differences in availability led to social restrictions and preferences in the diet of this society. Foods like corn and deer were mainly enjoyed by the chiefly classes, while products that included tubers and fruits, like the *ahuyama*, were avoided by the elites and became the sustenance of the lower classes. Methods for the preparation of foods, such as *chicha* and *arepas* from corn, were also

restricted and these products were mainly used by the chiefly classes, with the exception of celebratory occasions such as feasts and weddings or during communal labor efforts. The analysis of Muisca artifacts associated with the production, acquisition, and consumption of foods is another fundamental tool in order to reconstruct this ancient diet. It is clear that the great majority of Muisca ceramics are associated with processing, serving, and storing food products. Therefore is essential to understand Muisca ceramic traditions in order to understand the Muisca diet. In addition to the ceramics, a high number of stone tools and perishable materials that include bones and leather are also associated with dietary practices.

The identification and descriptions of the food products in this thesis is the direct result of the collection of data found in the archaeological record, ethnohistoric accounts, and ethnobotanical studies in this part of the Colombian Andes. Our understanding of the subsistence strategies of the Muisca and of their preferential and restrictive diets will result in a better set of theories that define the evolution of complex societies in South America. They also have implications for modern policies and politics. The preservation of the knowledge of foods used by the Muisca is important for modern society, as many of these products are still part of the modern Andean diet. With the current discussions on a free trade agreement between Colombia and the United States that have gained so much attention in the last few years, it is necessary for us to understand the role of Muisca food products for the modern Colombian society before this trade agreement is finalized. A free trade agreement without understanding the role of these products can result in the replacement of native foods by imported goods, as occurred in Peru (Peru currently has a free trade agreement with the U.S.) where imported foods have replaced important native crops (ACTIB 1989). It is also necessary to understand the utilization of these foods by the native populations in the Andes in order to maintain their traditional use unaltered.

As some of these products become popular outside their native range and their demand increases (*see* chapter on Quinoa), the products increase in price leading to a decrease or disappearance in their traditional use as native populations cannot afford them any longer. This can have detrimental effects in the nutrition of these populations leading to irreversible consequences that can cause the disappearance of native societies. Thus, it is necessary to reach a balance in production for export, while maintaining the supply of local products for the native populations that depend on it.

On the other hand if it is implemented correctly, a free trade agreement can also be beneficial in bringing these products out of their native environments and on to the tables of people around the world, as was the case of potatoes and corn during the conquest. Some of these products have interesting qualities, such as the high protein in quinoa, the frost resistance of *ibias*, or the pleasant flavor of *arracacha*; these may be useful in combating hunger and poverty. Some of these agricultural products can be used to develop new varieties of foods that can resist climatic change or survive in harsh environments, as well as aid in the creation of genetically modified crops that can satisfy the nutritional needs and palates of people around the globe. In order to achieve such optimistic goals, it is first necessary that we understand these indigenous crops and how they were used by the Muisca and other native populations in the Andes. Hopefully, this thesis has provided a large part of that background.

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Cordial saludo,

IVÁN DARÍO GÓMEZ GUZMÁN  
Director General

Proyectó: Orlando Buitrago R.  
Revisó: Ivanna Nussika Agudelo P.  
Octubre 10 de 2011

## **APPENDIX B. GENERAL AND BOTANICAL DESCRIPTIONS**

### **Tubers and Roots:**

**Achira, *Canna edulis*:** Flour 1,000 Colombian pesos per lb. The white, yellow crackers salty soft and crunchy. Ramo: 25g 10pks. Per 14,850 pesos. Achiras del Huila, 1200 pesos 25g.

Ingredients: achira flour, cheese, eggs, margarine and salt. 125 calories, fat 6.6g 10.2%. trans fat 0.002g, cholesterol 0.01mg, carbs: 11.3g 3.8%, Protein 5.0g, calcium 21.3mg. Iron: 18.2g. Phosphorus: 100g.

**Arracacha, *Arracacia xanthorrhiza*:** (all tubers and roots flavors are described after boiling):

Exterior: light brown to large yellow with a rough texture. Cylindrical root. Flesh is pale yellow in color. Center core approximately 3 cm in diameter. Outer rings 1-1.5 cm thick varies in color of white, yellow and purple. Flavor: similar to cooked carrots, earthy very gentle to the palate.

Smell: strong pleasant smell, sweet with a hint of wet earth.

Miniature: similar to larger variety, but much smaller 1.52mm of skin thickness, also rings but purple rings more intense. Same smell but taste a bit sweeter than larger varieties.

Chemical Composition: Eatable part 85%; Calories in 100% 104 cal; Protein % 1.10g; Water 71.90g; Fat 0.10g; Carbs 24.90g; Fiber % 0.80g; Calcium mg/100g 24.00mg; Phosphorus mg/100g 65.00mg; Iron mg/100g 0.70mg; Sorbic acid mg/100g 15.00mg; Vitamin A 20.00 UL, Thiamin 0.04mg; Riboflavin 0.03mg; Niacin 2.70mg (Acosta and Moreno 1997: 60).

**Batata/Sweet potato, *Ipomoea batatas*:** Tuber. Exterior: Light brown, similar to a typical sweet potato. Outer skin less than 1 mm thick. Odd non-geometrically shaped. Flavor: Sweet potato but

less sweet, earthy, very fresh and a light taste. Flesh pale orange. Smell: mild sweet earthy. No defining characteristics of the interior.

**Batata/Salty sweet potato:** Tuber. Exterior: purplish brown with a rough texture, outer skin less than 1 mm thick. Radish shaped. Interior flesh is marbled yellow and white with milky latex... Flavor: sweet, earthy, fibrous, strong taste, Smell: mild earthy.

**Cubios, *Tropadelum tuberosum*:** White: Exterior white and purple incisions, smooth texture. Cone shaped. Interior white and purple. 3.62mm of skin followed by a center core. Taste earthy, neutral, a bit sweet, texture is a little slimy, some are a bit bitter, texture similar to cooked potato. Resembles the flavor of red radish. Smell: earthy, strong sour aroma.

Yellow: Exterior dark yellow, darker yellow incisions, cone shaped, long tip, very smooth surface, 4.01 mm skin followed by a center core. Interior: Dark yellow on the borders, and lighter yellow of flesh.

**Chuguas/rubas, *Ullucus tuberosus*:** Brown variety: Exterior dark purple and brown. Commonly spherical shape like common potatoes, but some are (cone, long cylindrical, curved and irregular shapes) very smooth surface. Skin 2.95mm thick, followed by a lighter core and a dark purple center, Taste: Very similar taste as beads, as well as the smell.

Purple variety: Exterior bright purple much brighter than brown variety. Shape same, smooth surface. Skin: 2.52mm thick. Followed by lighter core and a bright purple center. Taste and smell very similar to beads. Texture of interior is slimy or gummy in all the varieties observed.



Yellow/green variety: Exterior light green and yellow, same shape as brown, skin 2.05. Followed by a yellow core and a green center. Taste: like beads a bit sourer and less sweet. Smell: Like beads. Most common variety (ACTIBS 1989: 108).

**Ibias/oca, *Oxalis tuberosa*:** Exterior: Pink and red with purple incisions, smooth texture except where the incisions occur. Cone shaped. Skin 1.13mm thick, followed by a white core, white beige ring 2.62 from the exterior, and 1.26 mm thick. Taste: Smell: earthy, mild sweet, gardenia soft smell.

**Potatoes:** *s.tuberosum* chemical composition: Eatable part 100%; Calories in 100% 84 cal; Protein % 1.90g; Water 76.70g; Fat 0.10g; Carbs 19,30g; Fiber % 1.00g; Calcium mg/100g 4.80mg; Phosphorus mg/100g 26.00mg; Iron mg/100g 1.10mg; Sorbic acid mg/100g 20.00mg; *s.phureja criolla* chemical composition: Eatable part 100%; Calories in 100% 83 cal; Protein % 2.50g; Water 75.20g; Fat 0.10g; Carbs 18,70g; Fiber % 2.20g; Calcium mg/100g 7.0mg; Phosphorus mg/100g 54.00mg; Iron mg/100g 1.00mg; Sorbic acid mg/100g 15.00mg; (Acosta and Moreno 1997: 42).

**Yuca :** Chemical Composition: Eatable part 80%; Calories in 100% 146 cal; Protein % 0.80mg; Water 61.80g; Fat 0.10g; Carbs 35,50g; Fiber % 0.90g; Calcium mg/100g 27.00mg; Phosphorus mg/100g 35.00mg; Iron mg/100g 0.40mg; Sorbic acid mg/100g 30.00mg; Vitamin A 10.00 UL, Thiamin 0.04mg; Riboflavin 0.03mg; Niacin 0.5mg. Yuca varieties in Colombia: colorada, antioquia, comun, algodona, barranquiña, llanera, Ch, lengua de pisco, negrita, Ch-fina, guajiba, cadena, manteca, Montero, botoncito, blanquita, (Acosta and Moreno 1997: 49).

## **Legumes**

**Frijol Común/ Cargamanto:** Exterior inside a pod pink and yellow to light green long and rounded at the edges, inside of the pod is white and fleshy, usually. Bean color pink and white marbled, with a bean like elliptical shape. Flavor: earthy, bit tart, strong flavor, turns pink when cooked 1,000 per lb. or .50 lb.

**Chachafruto *Erythrina edulis*:** Bean pod not present. Bean is large, dark brown in color with a smooth surface. Regular bean shaped. No smell.

**Guama, *Inga feuillei*:** Exterior: Encased in a pod, legume, dark lime green various shapes, some long straight others curled crescent moon shaped, hard casing, woody, ridges present, superior ovary, casing mesocarp 6mm, Interior: the casing is white inside and crack open casing to reveal the pulp which encases the large seeds. The pulp is a white cotton like which separate easily from the pod. Seeds are black and dark purple, split in halves easily, and bean shape smooth and shiny, 4.5 cm long. Taste: Cotton like texture, very sweet, soft and pleasant, eaten as a fresh fruit only the pulp is consumed. Smell: mild sweet smell, refreshing.

## **Fruits**

**Calabaza Verde, *Curcubita pepo*:** Exterior: Light green yellowish pale, pericarp 3mm thick, smooth skin, oval shape, squash, inferior ovary, pepo, 6 carpals, Mesoderm Light white to light green spongy texture 9.6 cm. Flesh/pulp pale green to white, covering seeds, seeds white tear shape 1.75 cm typical squash seeds. Taste: Similar to cucumber, refreshing light taste. Typically boiled similar to yellow squash or baked. Smell: Fresh mild taste similar to cucumber. Price: 1,000 pesos a Lb. = .50US.

**Lulo, *Solanum quitoense*:** Exterior: Bright orange pericarp, skin 3.1 mm. Rough skin scabrous, stiff hairs irritate skin, perennial, herbaceous shrub. Interior: Superior ovary, with four carpals. Flesh translucent yellow. Seed multiple 4mm long, green flesh surrounding the seeds similar to a tomato. Taste not sweet, sour, acidic, not usually eaten as a fresh fruit. Used in Colombia mainly to make juice something as a national drink. The juice is made by cutting the fruit in half and placed in a blender with the skin and seeds (entire fruit) adding water, and sugar. After is blended it is strained to remove seeds and skin. Taste of juice is acidic, sour similar to lemonade and very refreshing. Smell: Fresh and aromatic and someway citrus like. In the market Codabas at Bogota it runs for 2,000 pesos a Lb. = 1 US. In the market at Paloquemao in the South of Bogota runs from 1,000 pesos a Lb. = .50 US.

**Goldenberry/Uchuva, *Physalis peruviana*:** The goldenberries are encased inside a bell shaped calyx with five sections, which resemble straw-colored pale yellow leaves, with fussy pubescent and the steam on the calyx. This husk is removed before consumption of the fruit. The fruit is a

sphere of a yellow to pale orange; the skin is very thin less than 1 mm and smooth. Interior: a bit lighter yellow than the skin but very similar. Many seeds like a small tomato, two carpals in the shape of two half-moons joined at the middle. Seeds are about 1.5mm long. Superior ovary.

Taste: Mildly sour with a bit of sweet, juicy, and light very pleasant to the palate. Smell: Similar to the lulo aromatic and citrus like. Commonly eaten as a fresh fruit, as well as added to salads, can be also made into jams, and used to make a traditional dessert adding sugar to make syrup, also used as a culinary garnish and decoration. Runs for 1,800 pesos a Lb. = .90 Lb. In Paloquemao is 1,000 pesos a Lb. = .50 US.

**Guava *Psidium guajava*:** White variety Exterior: Round, light apple green with brown marks, thin skin less than a 1mm. Inferior ovary, 6 carpals. Mesoderm white-green, firm, 1cm. Pulp surrounds many seeds, firm same as mesoderm. Seeds are round off white in color, 3.5mm long. Entire fruit is consumed eaten as a fresh fruit, made into juice, dessert, jelly. Taste: Mildly sweet aromatic, mealy texture similar in taste as a pear. Smell: Not too strong but very refreshing. Price: 2,000 pesos a Lb. = 1US. Red Variety (*Pera*) Exterior: pear like shape, apple green, and yellow, relatively smooth skin, less than 1 mm. Inferior ovaries 4 carpals. Mesoderm pink and green 1 cm thick. Pulp pink firm, 1cm, seeds are yellow 3mm, Taste: Sweeter, creamer, than white variety, stronger taste than white variety. Smell: refreshing, tropical, sweet. Price: same as white variety.

**Tomate de Arbol, *Cyphomandra batacea*:** 3 varieties común, rojo and Amarillo.

Común: Exterior: Smooth pale red in color skin. Thin pericarp with a mesoderm of approximately 5 mm thick. Fruit is egg shaped, very pointed at the base with the stem attached to

the fruit. Superior ovary, 2 carpals. Mesoderm light orange meaty, Similar in color taste and appearance to the goldenberry. Pulp is darker than the mesoderm pale, translucent orange encasing the seeds which are light orange 5mm long oval shape. The entire fruit is used to make juice and is also used to make a traditional dessert by peeling the skin and adding sugar to make syrup and boiled. Taste: distinctive taste a bit sour, not too sweet, similar to papaya, mild flavor, pungent flavor. Smell: Flowers, similar to the goldenberry. Price: 1,500 pesos a Lb.: .75 US.

Rojo: Exterior: Dark red smooth skin. Mesoderm same color as común. Pulp is darker than común, and seeds are dark purple size 4mm. Same price as común. Smell sweeter than común but less aromática. Taste: More sour than rojo but very similar a bit sweeter. Price: Same as Común. Amarillo: Exterior: Dark yellow smooth skin. Mesoderm same as común. Pulp is a bit lighter than común. Taste: more sour than rojo, taste similar to a tomato. Firm pulp and mesoderm. Smell: milder than the rojo and común. Price: 2,000 pesos a Lb. = 1US.

**Anón, *Annona squamosa*:** Aggregate fruit each segment is a carpal. Exterior: dark and light green, black, divided in multiple segments oval shape skin is tough and rough, 7.5mm thick, each segment can be separated individually. Mesoderm thin white .7 mm also a bit of brown. Pulp is white gelatinous, surrounds seeds, which are black oval, multiple 1.3 cm. Only the pulp is consumed usually eaten as a fresh fruit in Colombia. Taste: Very sweet, like pudding similar to sour soap. Smell: very mild, forest smell, pleasant. Price: 1,500 pesos a Lb. = .75 US.

**Cherimoya, *Annona cherimola*:** Aggregate fruit. Exterior. Apple shaped, dark green, lathery skin, whit small incisions; skin is 1.08mm, tough skin. Mesoderm blends with pulp white in color. Pulp surrounds seeds, fewer than anon, black in color, 1.5 cm long, same family as anon

and guanábana. Only the white pulp is consumed as a fresh fruit or juice. Taste: Sour milky sweet taste, aromatic, creamy, a bit dry compared to the anon. Smell: aromatic, sweet, mild.

Price: 2,000 pesos a Lb. = 1 US.

**Papayuela, *Carica candamarcensis*:** Exterior: Bright yellow, smooth, five parts or angles, elliptical shape. Inferior ovary, 5 carpals. Skin is very thin less than a mm. Mesoderm is pale yellow firm and 1.30 cm. Pulp surrounds the seed, white. Seeds many nodules, elliptic shape dark brown 7.5mm. Only the pulp is used after peeled, and seeds are extracted. It is consumed as a dessert in syrup not eaten raw. Taste: It is not sweet pungent as a papaya without the sweet. Smell: Sweet smells same as a Hawaiian papaya. Price: 1,000 pesos a Lb. = .50 US.

### **PassionFruits**

**Chulupa, *Passiflora maliformis*:** Exterior: Light yellow with light green coloration, white spots, skin less smooth than other passion fruits, small protuberances. Mesocarp 7.2 mm, skin is strong and tick superior ovary, three carpals. To consume the pulp and the skin are cracked open divided in halves can be eaten as a fresh fruit or made in to juice. Mesoderm is white detaches easily from the pericarp. Small white bristles attaches to each of the seeds. The pulp is translucent yellow, gelatinous and surrounds the multiple black seeds that can exceed 200 seeds are 5mm long. Taste: sweet and sour, very pleasant refreshing. Smell: sweet smell mild, similar to gurupa, maracuya. Price 800 pesos per lb.

**Granadilla, *Passiflora ligularis*:** Exterior: Light to mild orange, smooth skin, with small white dots, round shape, with a long strong stem usually cut and left on the fruit. The skin is thick and relatively strong about 4mm thick. superior ovary, three carpals. To consume the pulp the skin is cracked open and the fruit is divided in halves. Between the skin and the pulp there is a mesoderm of white color which detaches easily from the pericarp and this mesoderm is cotton like with small bristles towards the interior of the fruit. The pulp is translucent, gelatinous and surrounds the multiple gray seeds that could exceed 200 and the seeds are about 7mm in length. Only the pulp and the seeds are consumed usually as a fresh fruit but could also be made into juice but this is rare in Colombia. Taste: Very sweet taste like sugar water very pleasant, a very tiny bit of sour flavor from the seeds is also felt when eaten, the texture is gelatinous and might be unpleasant for some people, but it is one if not the most sweet of the passion fruits in Colombia. Smell: very tropical. Sweet and aromatic. Price: 2000 pesos a Lb. = 1US.

**Gulupa, *Passiflora pinnafistipula*:** Exterior: Dark purplish brown with some protuberances and resemble small potatoes. The skin is smooth and relatively hard similar to the granadilla's and is about 5mm thick. It has three carpals, inferior ovary. When cut open the pericarpal is a pink reddish color. It has white mesoderm cotton like with bristles towards the pulp. The pulp is a translucent dark yellow. It has black seed tear drop shape seeds, about 5.5 mm long, and each fruit contains about 100 of them. The pulp is gelatinous. Only the seeds and the pulp are consumed usually made into juice or eaten as a fresh fruit. Taste: Very sour not too sweet at all, a bit like a yellow lemon. It tastes similar to the Brazilian Maracuya. Smell: Very aromatic as most passion fruits, fruity smell, and refreshing. Price: 2,500 pesos a Lb. = 1.25 US.

**Curuba, *Passiflora mollissima*:** Exterior: Green to pale yellow with soft fussy pubescent skin. It is cylindrical in shape with pointy edges; it is called sometimes the banana passion fruit as its shape resembles this fruit. Skin is about 4mm thick very soft skin unlike granadilla and the gulupa. It has a mesoderm of white color cotton like with bristles towards the interior that easily separates from the skin. Inferior ovary with 3 carpals. Pulp is gelatinous and dark orange surrounding many seeds probably more than 300 seeds which are black in color, tear shape 6.5 mm long. Only the seeds and the pulp is consumed usually made into juice but is also eaten as a fresh fruit. Taste: Sour and refreshing, when made in to juice has a mild banana flavor, the pulp and the seeds are blended with milk, water and sugar to make the traditional sorbet de curuba highly consumed in Colombia. Smell: It is a sweet smell, highly aromatic like flowers, refreshing. Price: 2,500 pesos a Kg= 1.50 US.

**Badea, *Passiflora quadrangularis*:** Exterior: Apple green colored smooth pericarp. Cylindrical in shape. Inferior ovary, 3 carpals. Similar in shape size and color to a green squash. Skin thick up to 2.5 cm. Mesoderm white to light green in color, relatively hard compared to other passion fruits. Pulp is gelatinous translucent white covering the seeds which are about 200-300 per fruit. Each seed connected to the bristles in the mesoderm. Seeds are almost 1 cm long, black with three ridges at the top. The pulp the mesoderm and the seeds are consumed mainly as a juice not eaten as a fresh fruit in Colombia. Taste: Sour, ginger like flavor, mild sweetness, blended into juice as explained for the other passion fruits with or without milk with the exception that the mesoderm is used for this plant. Smell: Mild melon aroma, refreshing. Price: 1500 pesos a Lb. = .75 US Lb.



## **Berries**

**Agras, *Vaccinum meridionale*:** Similar to blueberries, round purple in color, sweet, juicy, thick skin, eaten as a fresh fruit in yogurt, jams, and desserts in Colombia. Four carpals, inferior ovaries, Interior translucent green with seeds of same color 1.67mm Bit sour. Smell: Strong like wine. Price: Codabas 25,000 pesos a Lb. = 12.50 US. Paloquemao market 18,000 pesos a Lb. =9US.

**Zarzamora/Moron, *Rubus macrocarpus*:** Aggregate of dropes. Purpple in color, multiple aggregate dropes, 4.5mm each, oblong shape, compact pulp. Taste: Very acid, aromatic, not sweet at all, sour, white center. Smell: Berry like, wine smell. Used in juice, desserts, entire fruit is used not eaten as a fresh fruit because its acidity. Price: 1,500 pesos a Lb. = .75 US

**Mora de Castilla, *Rubus glaucus*:** Same as zarzamora but much smaller in size. 3.0mm dropes Price 1,800 pesos a Lb. In the Codabas much more expensive than Paloquemao.

**Mora Silvestre, *Rubus adenotrichus*:** Small wild *moras* small and entire bush is used including the fruits to make tea to treat cold. Same as other moras but very small in size .9mm each, dropes are 2mm. The plant has alternate leaves, with above leaves, serate margins, parallel veins, minute fussy pubescent on the underside of the leave, woody steams with spines, large brown hairs on steams, 2mm long. Flowers with 5 sepals.

### **Leafs**

**Coca, *Erythroxylum coca*:** Woody shrub, brown steams, alternate leaves, obobate (upside-down teardrop), dark green, smooth surface, underside of leave light gray. Taste: bitter taste, taste similar to green tea. Smell: similar to hay, soil.

## APPENDIX C: TABLES

Table 1: This table shows agricultural crops used by the Muisca before the conquest, common names, botanical names, varieties, origins, nutritional information, and uses for these plants.

Crop Type	Family	Botanical Name	Varieties	Common Names (Sp for Spanish)	Origin	Nutrition 100g (from ACTIBS, 1989 unless cited)	Uses (modern unless stated)
<b>Roots and Tubers</b>							
Achira	Cannaceae	<i>Canna edulis</i>	In the Andes two type of var. <i>Verdes</i> , <i>Morados</i>	Colombia Sp: Achira Muisca Chibcha: Chisgu/rijua Quechua: Achira English: achira/ edible canna	Bolivian Piedmont (Langebaek, 1994). Earliest evidence 2500 BC Peru (ACTIBS, 1989:36)	75% moisture, 75-80% starch, 6- 14% sugar, 1-3% Protein, Potassium high	In Colombia is used to make salted crackers from flour
Arracacha	Apiaceae	<i>Arracacia xanthorrhiza</i>	Blanca, Morada Amarilla in Colombia	Colombia Sp: Arracacha Quechua: Laquachu/ rakkacha English: White carrot/ Peruvian carrot/ Peruvian parsnip	Colombia (Sauer, 1950) Ecuador, Colombia and Peru (ACTIBS, 1989:54)	10-25% starch, calcium high, vitamin A high	In Colombia is used in the main typical dish of Bogotá the <i>ajiacó</i>
Cubios	Tropaeolaceae	<i>Tropaeolum tuberosum</i>	More than 100 varieties have been recognized. In Colombia endemic varieties var. <i>Pilifera</i> var. <i>Lineovaculata</i> .	Colombia Sp: Navo Muisca Chibcha: Cubios Colombian Paez: Puel Quechua: Mashua English: Mashua/ anu	3000+ m elevation in Peru and Ecuador (ACTIBS, 1998:72)	16% protein, 371 calories, 4.3g fat, 78.6g carbs., 5.7g of fiber 50mg calcium, 300mg phosphorous, 8.6mg iron.	Ancient: anti- aphrodisiac for armies (Cobo, 1956). Modern: In stews, baked, fried, flowers are also eaten. (in the Andes is associated with poverty)
Ibias	Oxalis	<i>Oxalis tuberosa</i>	Andean indigenous groups recognize more than 12 varieties.	Colombia Sp: Ibias Quechua: Okka English: Oca	One of the oldest Andean crops. Andean crop possibly Peru.	12% carbs, 1% fat, and fiber, up to 9% protein, amino acids, easily digested	Used in stews soups and desserts and in the traditional <i>cocido boyasence</i> .
Ulluco	Basellaceae	<i>Ullucus tuberosus</i>	Enormous variety, I have seen more than six types in	Colombia Sp: Ullucos/ rubas/ papa lisa (Nariño)/ lisas/ olluco	Completely domesticated no wild varieties. Represented in	85% moisture, 14% starch, 1-2% protein, high vitamin C, 381 calories, 75g of	Boiled, mashed, grated, pickled, freeze-dried. Can be stored for up to a

Crop Type	Family	Botanical Name	Varieties	Common Names (Sp for Spanish)	Origin	Nutrition 100g (from ACTIBS, 1989 unless cited)	Uses (modern unless stated)
			Colombia.	Muisca Chibcha: Chugua Paez: Lao Quechua: Ulluco English: Ulluco/ melloco	Muisca iconography, found in 4300 year old ruins in costal Peru (ACTIBS, 1989:112).	carbs. 0.6-1.4g of fat.	year at room temperature. Leafs can be also eaten.
Jicama	Asteraceae (sun flower family)	<i>Polymnia edulis</i>		Colombia Sp: Jicama/ jiquimilla Quechua: Yacón English: Yacon strawberry/ jiquima	Jícama grows wild in Colombia so it might have originated in this region. It has been found in pre-Inca tombs in Peru, wide dispersal in early times (ACTIBS, 1989:122).	69-83% moisture, 0.4-2.2% protein, 20% sugars, 1.3% fat, high potassium.	Colonial: Food for sailors. Modern: Eaten raw, Squeezed for making a drink, boiled, baked,
Potato	Solanaceae (up to 200 kinds of potatoes)	<i>Solanum tuberosum</i>	Two varieties in Muisca region (Reichel Dolmatoff, 1965:159).	Colombia Sp: Papa común. Muisca Chibcha: Iomuy, yoma	Peru and Bolivia (Langebaek, 1994:4). Approximately 8000 years ago cultivated in the Andes (ACTIBS, 1989).	2.g of protein, 17g of carbs., approx. For more information on potato nutritional values see HN Englyst and JH Cummings (1987).	Common knowledge.
Potato	Solanaceae	<i>Solanum colombianum or phureja</i>	(Acevedo, 2005): <i>Colombia, Paisa, Latin</i>	Colombia Sp: Papa criolla Muisca Chibcha: <i>tybaiomy</i>	Colombia (Patiño, 1990).		In Colombia is fried or baked.
Potato	Solanaceae	<i>Solanum andigena</i>		Colombia Sp: Papa andigena	Peru. Ancestral to the potato that reached Europe in the XVI century and became the staple food of many European nations.		Is the best known potato in Latin American countries used in an wide range of traditional dishes.
Sweet Potato	Convolvulaceae	<i>Ipomoea batatas</i>		Colombia Sp: Batata Muisca Chibcha: Miz/ mizipa	The Andes. In Colombia the earliest evidence for domestication		Baked, desserts, boiled.

Crop Type	Family	Botanical Name	Varieties	Common Names (Sp for Spanish)	Origin	Nutrition 100g (from ACTIBS, 1989 unless cited)	Uses (modern unless stated)
				English: Sweet potato	from Musica region from Zipacón 3270+/-35 BP (Correal and Pinto, 1983:181).		
Yuca	Euphorbiceae	<i>Manihot esculenta</i>	Sweet and Bitter (Reichel Dolmatoff, 1965).	Colombia Sp: Yuca Muisca Chibcha: Aro Paez: Lom Quechua: Rumu English: Manioc	Colombia (Reichel Dolmatoff 1965:62).	1% protein, no vitamins, 86% carbs (Brintnall and Conner, 2001). Third largest producer of carbohydrates for humans.	Ancient: prepared a coarse flour <i>manioco</i> , made to make flat cakes known as <i>cazabe</i> . Modern: Boiled, fried, mashed, in <i>bollos de yuca</i> , soups, leafs are also eaten.
<b>Grains</b>							
Corn	Poaceae	<i>Zea maize</i>	Muisca varieties: <i>Arroz</i> , <i>Amarillo</i> , <i>Rosado</i> , <i>Tunebo</i> <i>A</i> , <i>Tunebo B</i> , <i>Pollo</i> , <i>Pira</i> , <i>Sabanero</i> , <i>Cabuyo</i> , (Parra, 2005)	Sp: Maíz Colombia on the cob: Mazorca. Quechua: Cara English: Maize/ corn Muisca: <i>aba</i>	Mesoamerica 6000 BC to 5000 BC (Brintnall and Conner, 2001:129). In Colombia earliest evidence for cultivation in Calima territory 4000 BC to 3000 BC (Cárdenas- Arroyo, 2002:14; Bray et al., 1987).	11.1% moisture, 348 calories, 8.2g protein, 1.0g fat (Brintnall and Conner, 2001:114). C4 plant.	Ancient: The most important of the Muisca crops. It was mainly used in the preparation of Chicha a fermented drink widely consumed, also made into arepas, bollos. (Patiño, 1990).
Quinoa	Chenopodiaceae	<i>Chenopodium quinoa</i>	<i>Valley type</i> , <i>Altiplano Type</i> , <i>Salar Type</i> , <i>Sea</i> <i>Level Type</i> , <i>Subtropical</i> <i>Type</i>	Colombia Sp: Quínoa Muisca Chibcha: Suba/ pasca Quechua: Kiuna English: Quinoa	Domesticated independently in multiple locations in Bolivia, Ecuador, Peru, Colombia and Ecuador between 3000 to 5000 BP	16-23% protein, FAO standard for human nutrition in protein, high lysine, methionine, cystine, 58-68% starch, 5% sugars, 4-9% fat, higher calcium, phosphorus, and iron	In Colombia is still widely used, usually toasted and grinded into flour, boiled, in soups, also made into Chicha.
<b>Legumes</b>							

Crop Type	Family	Botanical Name	Varieties	Common Names (Sp for Spanish)	Origin	Nutrition 100g (from ACTIBS, 1989 unless cited)	Uses (modern unless stated)
Beans/ Frijol Común	Fabaceae	<i>Phaseolus vulgaris</i>	Muisca varieties: Huacaloma, San Rafael, Tunja (Pradilla, 2005).	Colombia Sp: frijol común. English: Popping beans, beans	Peru 11000 BP, Guitarrero cave in Ancash (ACTIBS, 1989:178). Argentina and Bolivia (Langebaek, 1994:4). Mexico, Colombia, and Peru (Brintnall and Conner, 2001:143).	8.3% moisture, 349 calories, 22.9g protein, 1.2g fat, 63.7g carbs., 4.3g fiber (Brintnall and Conner, 2001:142).	<i>frijoles</i> are used in a wide variety of traditional Colombian dishes including soups, and <i>guizos</i> .
Peanuts	Fabaceae	<i>Arachis hypogaea</i>		Colombia Sp: Maní English: Peanuts	Central and Eastern S. America (Brintnall and Conner, 2001:143). Andean piedmont Bolivia (Langebaek, 1994:4).	5.6% moisture, 564 calories, 26g protein, 47.5g fat, 18.6g carbs., 2.4g fiber (Brintnall and Conner, 2001:142).	In Colombia are usually roasted, boiled, or sugar coated.
Chachafruto	Fabaceae	<i>Erythrina edulis</i>	none	Colombia Sp: Chachafruto	Unknown	20% protein, rich in lysine and phosphorus	Seeds are boiled in water, mashed, can be eaten raw, leaf are eatable.
<b>Fruits</b>							
Guama	Leguminosae	<i>Inga feuillei</i>	Several species are recognized. <i>Inga feuillei</i> is pre-Columbian.	Colombia Sp: Guama. Quechua: Pa'qay English: Ice-cream beans	Eastern slope of the Andes, in iconography 1000 B.C. at Peru (ACTIBS, 1989:283).	No nutritious, 1% protein, 15% carbs.	The flesh around the seeds is eaten raw.
Ahuyama/ Calabaza	Curcubitaceae	<i>Curcubita pepo</i> <i>C. maxima</i>	There is a wide variety of this species including the summer squash, zucchini, acorn squash. In Colombia ahuyama is the most commonly	Colombia Sp: Ahuyama. Sp: Calabaza English: Squash	Mexico or S. America (Brintnall and Conner, 2001:76). In Muisca area earliest evidence from Aguazuque dated to 32170+/- 30 BP (Correal, 1990:261).		Ancient: Squashes in the new world were usually combined with corn and beans "three sisters".

Crop Type	Family	Botanical Name	Varieties	Common Names (Sp for Spanish)	Origin	Nutrition 100g (from ACTIBS, 1989 unless cited)	Uses (modern unless stated)
consumed							
Pepper	Solanaceae	<i>Capsicum annuum</i>		Colombia Sp: Aji English: Pepper	Mexico 7000 BC (Brintnall and Conner, 2001:76). Peru, Bolivia and Argentina early evidence <i>ca.</i> 8000 or 7000 BC (Pearsall, 1992:181-187; ACTIBS, 1989:195).		To make hot sauces and as a condiment, also cooked and eaten filled with meat and cheese.
Goldenberry	Solanaceae	<i>Physalis peruviana</i>		Colombia Sp: Uchuva Quechua: Totopo English: Goldenberry	It grow wild in the Colombian Andes above 2,200m and probably originated there.	High vitamin A, C, B-complex, high protein for a fruit, and high phosphorus.	Eaten raw, in salads, sauce for meats, desserts, jams.
Lulo	Solanaceae	<i>Solanum quitoense</i>	Quitoense, Septentrionale both found in Colombia	Colombia Sp: Lulo Quechua: Lulo. English: Quito orange	Unknown origin, but most probably native to Colombia. First record of domestication from Colombia in the 1600's).	23 calories, 92.5g protein, 0.6g fat, 5.7g carbs.	In Colombia is usually made into juice considered to be the national drink in the country.
Pineapple	Bromeliaceae	<i>Annanis comosus</i>		Colombia Sp. Piña	S. America		
<b>Passion Fruit</b>							
Curubas	Passifloraceae	<i>Passiflora mollissima</i> <i>P. mixta</i> <i>P. cumbalensis</i> <i>P. achlimiana</i> <i>P. ambigua</i>	“Colombia has some outstanding varieties” (ACTIBS, 1989:289).	Colombia Sp: Curuba English: Banana passion fruit	Andean valleys from Venezuela, Colombia, Bolivia and Peru (Brintnall and Conner, 2001:76).		In Colombia is usually made into juice, jams, gelatin, ice cream.
Colombian Passion Fruit	Passifloraceae	<i>Passiflora antioquiensis</i>	No known varieties.	Colombia Sp: Curuba paisa English: Colombian passion fruit	Native to the Colombian Andes.		Use for juice, eaten raw, in desserts.
Chulupa	Passifloraceae	<i>Passiflora maliformis</i>		Colombia Sp: Chulupa	Native to the Colombian Andes near Bogotá at		In Colombia is made into juice or eaten fresh.



Crop Type	Family	Botanical Name	Varieties	Common Names (Sp for Spanish)	Origin	Nutrition 100g (from ACTIBS, 1989 unless cited)	Uses (modern unless stated)
					elevations from 1,200m to 1,500m.		
Rosy Passion Fruit	Passifloraceae	<i>Passiflora cumbalensis</i>	Seven varieties. “The variety found in Bogotá is the best of the species” (ACTIBS, 1989:293).	Colombia Sp: Curuba Bogotana English: Rosy passion fruit	Native to Cundinamarca, Colombia but tends to hybridize with other species.		Is used to make juice, yogurt, ice cream, and desserts.
Gurupa	Passifloraceae	<i>Passiflora pinnaefistipula</i>		Colombia Sp. Gurupa Chibcha: Gualchapa	S. America		Made into juice or eaten fresh
Granadilla	Passifloraceae	<i>Passiflora ligularis</i>		Colombia sp. Granadilla	S. America		Eaten fresh
Badea	Passifloraceae	<i>Passiflora quadrangularis</i>		Colombia Sp. Badea	S. America		For juice and eaten fresh
<b>Tree Fruits</b>							
Chirimoya	Annonaceae	<i>Annona cherimola</i>	White, Pierce, Knight, Bonito, Chaffey, Ott, Whaley, and Oxhart	Colombia Sp: Chirimoya Quechua: Chirimuya English: Cherimoya/ cherimoyer, annona	Appears in pre- Inca pottery (ACTIBS, 1989:237) Peru and Ecuador (Langebaek, 1994:4)	Sugar content high, calcium and phosphorus 35g, high thiamine, riboflavin, and niacin.	Pulp is eaten when ripe, to make ice cream.
Guanabana	Annonaceae	<i>Annona muricata</i>		Colombia Sp: Guanabana English: Soursop	Colombia and N. South America (Langebaek, 1994:4).	Sugar content high, calcium and phosphorus 35g, high thiamine, riboflavin, and niacin.	In Colombia is usually made into juice or a milk based drink.
Anón	Annonaceae	<i>Annona squamosa</i>					
Avocado	Lauraceae	<i>Persea americana</i>	5 varieties	Colombia Sp. Aguacate	Mexico and Central america	Good source of fat, protein	Eaten fresh
Guava	Myrtaceae	<i>Psidium guajava</i>	More than 100 species <i>P.</i> <i>guajava</i> is the most common	Colombia Sp: Guayaba English: Guava	Northern Andes (Langebaek, 1994:4). Central America (Brintnall and Conner, 2001:103).		Eaten raw, in juice, jams, and desserts, used in Colombia to make the traditional <i>bocadillo</i>

Crop Type	Family	Botanical Name	Varieties	Common Names (Sp for Spanish)	Origin	Nutrition 100g (from ACTIBS, 1989 unless cited)	Uses (modern unless stated)
Tree Tomato	Solanaceae	<i>Cyphomandra betacea</i>	Many varieties. Most common red and yellow.	Colombia Sp: Tomate de árbol. English: Tamarillo	Unknown. Possibly Bolivia	Excellent source of vitamin A, vitamin B6, vitamin C, vitamin E and iron. Less than 40 calories per fruit.	In Colombia is usually made into juice, and desserts.
Papaya and Papayuela		<i>Carica</i>	Multiple species and hybrids	Colombia Sp. Papaya and papayuela	S. America		Papaya fresh fruit and juice. Papayuela desserts
<b>Berries</b>							
Andean Blueberry	Ericaceae	<i>Vaccinium meridionale</i>	Seven varieties (Luteyn, 1981)	Colombia Sp: Arándano/ agras English: Andean blueberry	Colombian páramos 2,400m to 4,000m.		Eaten raw, yogurt
Mora	Rosaceae	<i>Rubus glaucus</i>	Wild and domesticated	Colombia Sp: Mora	Northern Andes		In Colombia is a cash crop grown in Bogotá mostly to make juice and jams, very popular in the country.
Zarzamora	Rosaceae	<i>Rubus macrocarpus</i>		Colombia Sp: Zarzamora English: Giant Colombian Blackberry	Native to inaccessible zone in the higher Andes of Colombia (2,600m to 3,400m) (ACTIBS, 1989:216)		Hard to grow outside its native region but widely marketed in Colombia
Mora Silvestre	Rosaceae	<i>Rubus adenotrichus</i>		Colombia Sp. Mora silvestre	Native to Central and S. america		Used as a fresh fruit and to treat fevers.
<b>Leafs</b>							
Coca	Erythroxylaceae	<i>Erythroxylum coca</i>		Sp: Coca Quechua: Kuka	South America, Peru, Bolivia (Brintnall and Conner, 2001:287). Peru (Langebaek, 1994:4).	No nutritional value but used as a stimulant, prevents altitude sickness, and lessens the feelings of hunger and fatigue (Brintnall and Conner, 2001:298).	Ancient: Coca was important for trade within Muisca territory. Sogamoso, Paipa, and others traded coca leaves with Tunja and Bacata (Bogotá) Coca was chewed usually with

Crop Type	Family	Botanical Name	Varieties	Common Names (Sp for Spanish)	Origin	Nutrition 100g (from ACTIBS, 1989 unless cited)	Uses (modern unless stated)
Guasca	Astereceae	<i>Galinsoga pawiflora</i>		Colombia Sp: Guasca	Andes.		calcium compounds such as seashells Used in Colombia in the traditional dish of Bogotá the ajiacó

Table 2: This table uses information from Pradilla *et al.*(2005) of mammal remains recovered at La Muela and Los Altos Santuarios in Tunja, Boyaca by the UPTC. (MNI) refers to the minimum number of individuals from the skeletal assemblage.

Mammals	Family	Species name	#frags. (UTPC)	MNI.	Common names Sp: Spanish Eng: English Chib: Chibcha Muisca	Uses
<b>Domestic</b>						
Guinea pig	Caviidae	<i>Cavia porcellus</i>	503	47	Sp: Cui, cava Eng: Guinea pig Chib: fucuy, fucos, sucui	
<b>Semi-domestic</b>						
Deer	Cervidae	<i>Odocoileus virginianus</i>	2557	28	Sp: venado cola blanca Eng: white-tailed deer Chib: <i>chihica</i>	Deer was only consumed by the chiefly classes. It is possible that it was semi-domesticated as they were either maneuvered by the Muisca like caribou in Northern region or were corralled.
	Cervidae	<i>Mazama rufina</i> <i>M. americana</i> <i>M. goazoubira</i>	1	1	Sp: venado rojo Eng: gray brocket deer Chib: <i>guahagui</i>	
Dog	Canidae	<i>Canis lupus</i>	0	0	Sp: Perro Eng: Dog	
<b>Wild</b>						
Armadillo	Dasypodidae	<i>Dasypus kappleri</i>	2	2	Sp: Armadillo/ jerre	

Mammals	Family	Species name	#frags. (UTPC)	MNI.	Common names Sp: Spanish Eng: English Chib: Chibcha Muisca	Uses
					jerre Eng: Armadillo	
Agouti	Dasyproctidae	<i>Agouti taczanowski</i>	1	1	Sp: Lapa Eng: Agouti	
Coati	Procyonidae	<i>Nasuella olivacea</i>	5	1	Sp: Coati Eng: cuatamundi/ coati	
Cotton rat	Muridae	<i>Sigmodon sp</i>	24	3	Sp: Rata de algodon Eng: Cotton rat	Cotton rats make their nests out of cotton and can damage cotton crops which the Muisca planted.
Cotton mouse	Muridae	<i>Sigmodon hispidus</i>	1	1	Sp: Raton Eng: Mouse	
Fox	Canidae	<i>Vulpes cinereoargentus</i>	1	1	Sp: Zorro gris Eng: Gary foz	
Crab eating fox	Canidae	<i>Cerdocyon thous</i>	3	3	Sp: Zorro de agua Eng: Crab eating fox	
Opossum	Didelphidae	<i>Didelphis marsupialis</i>	2	2	Sp: Fara Eng: Common opossum	
Puma	Felidae	<i>Felis concolor</i>	4	4	Sp: Puma, leon Eng: Puma, cougar	
Rabbit	Leporidae	<i>Sylvilagus brasiliensis</i>	3	3	Sp: Conejo brasileiro	

Table 3: Weight (wt), type, and condition from mammal bone samples analyzed at the UPTC Tunja, Colombia.

Species	ID	wt	condition	type
<i>Armadillo (Dasypus kappleri)</i>				
	n1044-11	4.5	good	?
	n0895-11	4.1	good	
<i>Coati (Nasuella olivacea)</i>				
	no595-48	3.6	good	maxila
	no665-9	3.8	good	maxila
<i>Deer (Odocoileus virginianus)</i>				
	N-superior	12.5	good firm discolored	tibia
	N66bull	52.9	poor	tibia
	N4bull	20.1	good	tibia
	n0679-1	41.4	good	mandible
<i>Opossum (Didelphis marsupialis)</i>				
	n0822-3	1.3	poor	?
	n2239-4	0.8	good	?
<i>Fox (Vulpes cinereoargenteus)</i>				
	g0041-6	9.2	good	mandible
<i>Guinea pig (Cavia porcellus)</i>				
	n0162-1	2.1	good	maxila
	n0627-1	0.6	good	pelvis
	n0699-6	0.5	good	scapula
	n0308-15	0.9	good	femur
	n0178-4	0.2	good	radius
	n0180-1	0.1	good	radius
<i>Puma (Felis concolor)</i>				
	n bull	10.5	good	maxila

Table 4: Measurements, material, munsell coloring, and function of Muisca artifacts analyzed at the Museo del Oro ceramic and stone tools deposit Bogotá, Colombia.

Muisca Stone tools	Code ID	L (cm)	W (cm)	T (cm)	wt (g)	Material	Color	Function
Metates	L00333	34.4	21.4	3.5-6.8	?	Granite/arenisca	Gray/brown/inclusions	grind corn
Metates	L00118	21.6	13	4.4	1600	Granite/arenisca	Hematite	grind corn
Sharpener/afilador	L00096	6.5	4.5	1.5	50.5	Granite/arenisca	Dark brown	sharpener
Sharpener/afilador	L00311	5.6	2.1	1.6	27.9	Granite/arenisca	Back	sharpener
Container yopo	L00347	5.1	3.9	1	24.9	Slate	Red/gray	contain/consume
Atlatl	L00060	2.6	1.5	0.7	4.2	Hematite? Jasper	Brown/gray	hallucinogenic
Atlatl	L00306	2.3	1.78	0.69	3.9	Granite/arenisca	Red	atlatl/gancho para lanzar
Atlatl	L00666	4.2	1.84	1.11	7.4	Granite/arenisca	Black	atlatl/gancho para lanzar
Atlatl	L00955	3.98	2.2	1.08	8.2	Granite/arenisca	Brown/yellow	atlatl/gancho para lanzar
Axes/hachas	L00108	9.61	7.26	2.21	222.8	Granite/arenisca	Green	atlatl/gancho para lanzar
Axes/hachas	L00320	9.28	4.55	1.98	174	Red stone/river	Brown/gray	multi
Axes/hachas	L00107	21.8	7.93	3.87	1311.5	cobble	Red	multi
Mortar	LN1244	D=14.2	L=20.5	4.28	965.2	Granite/arenisca	Gray	multi
Mortar	L00078	D=12.11		5.18	99.7	Granite/arenisca	Very dark gray 5yr 3/1	crush
Pestle	L00390	D=5.1	L=5.3		109.6	Granite/arenisca	Gray N06 7.5 yr	crush
Mano	L00961	19.2	9.03	6.98	1933.4	Granite/arenisca	Dark redish brown 3/2 7.5 yr	crush
Mano	L00962	19.4	10.76	7.29		Granite/arenisca	Light gray/brown	Grind corn
Fishing net weight	L00526	D=8.64	L=8.17		807.1	Granite/arenisca	White 8/2 5yr	Grind corn
Mortero	L00334	14.53	8.98	4.36	1149.1	Granite/arenisca	7.5 yr 4/2 dark brown	weight fishing net
							Very dark gray 5yr 3/1	crush

L= length. W= width T= thickness. Wt= weight.

Table 5: Mean roots and tubers size measurements ( $\pm$  standard error) of products purchased in Cundinamarca and Boyaca, Colombia.

Crop	Variety	Species name	n	W	L	H	wt
Cubio	white	<i>Tropaeolum tuberosum</i>	9	$3.4 \pm 0.11$	$9.7 \pm 0.93$	-	$45.1 \pm 6.09$
Cubio	yellow	<i>T. tuberosum</i>	12	$3.4 \pm 0.12$	$11.5 \pm 0.66$	-	$65.1 \pm 4.78$
Sweet Potato	salty	<i>Ipomoea batatas</i>	1	$8.8 \pm 0$	$11.1 \pm 0$	$7.0 \pm 0$	$300.8 \pm 0$
Sweet Potato	sweet	<i>I. batatas</i>	1	$5.1 \pm 0$	$16.3 \pm 0$	$4.7 \pm 0$	$196.2 \pm 0$
Arracacha		<i>Arracacia xanthorrhiza</i>	1	$5.2 \pm 0$	$18.1 \pm 0$	-	$269.7 \pm 0$
Arracacha	miniature	<i>A. xanthorrhiza</i>	12	$3.4 \pm 0.13$	$6.0 \pm 0.37$	-	$33.9 \pm 1.08$
Ibias		<i>Oxalis tuberosa</i>	20	$1.9 \pm 0.07$	$5.2 \pm 0.42$	-	$12.8 \pm 1.6$
Papa Criolla		<i>Solanum phureja</i>	14	$4.3 \pm 0.08$	$3.7 \pm 0.1$	-	$40.4 \pm 2.17$
Chuguas	purple	<i>Ullucus tuberosus</i>	30	$1.6 \pm 0.07$	$2.2 \pm 0.16$	-	$4.1 \pm 0.63$
Chuguas	yellow	<i>U. tuberosus</i>	30	$1.8 \pm 0.08$	$2.2 \pm 0.13$	-	$5.3 \pm 0.69$
Chuguas	brown	<i>U. tuberosus</i>	30	$1.9 \pm 0.08$	$2.7 \pm 0.19$	$1.7 \pm 0.08$	$6.9 \pm 0.96$
Papa Sabanera		<i>S. tuberosum</i>	5	$6.3 \pm 0.27$	$6.6 \pm 0.49$	$4.1 \pm 0.24$	$109.4 \pm 19.61$
Papa Rucki		<i>S. rybinii</i>	30	$3.0 \pm 0.08$	$2.4 \pm 0.07$	$2.7 \pm 0.08$	$13.0 \pm 0.85$

n= sample size. W= width. L= length. H= height. Wt= weight.



Table 6: Mean grains size measurements ( $\pm$  standard error) of products purchased in Cundinamarca and Boyaca, Colombia.

Crop	Species name	n	dm (mm)	W	L	wt.
Corn	<i>Zea mays</i>	2	-	$4.8 \pm 0.09$	$13.7 \pm 0.4$	$147.4 \pm 1.8$
Quinoa	<i>Chenopodium quinoa</i>	5	$2 \pm 0.1$	-	-	-

Table 7. Mean legumes size measurements ( $\pm$  standard error) of products purchased in Cundinamarca and Boyaca, Colombia.

Crop	Species name	n	W	L	H	wt	#sds
Frijol o	<i>Phaseolus</i>	14	$1.9 \pm$	$16.2 \pm$	$1.5 \pm$	$18.7 \pm$	$5.3 \pm$
Cargamanto	<i>vulgaris</i>		0.03	0.7	0.03	1.0	0.22
Chachafruto/Nunas	<i>Erythrina edulis</i>	1	$2.4 \pm 0$	$45.3 \pm 0$	$2.6 \pm 0$	$16.8 \pm 0$	$1 \pm 0$

Table 8. Mean leaf size measurements ( $\pm$  standard error) of products purchased in Cundinamarca and Boyaca, Colombia.

Crop	Species name	n	W	L
Coca	<i>Erythroxylum coca</i>	10	$2.1 \pm 0.1$	$3.6 \pm 0.1$
Guasca	<i>Galinsoga pawiflora</i>	9	$4 \pm 0.3$	$5.1 \pm 0.3$

n= sample size. W= width. L= length. H= height. Wt= weight.

Table 9: Mean fruits size measurements ( $\pm$  standard error) of products purchased in Cundinamarca and Boyaca, Colombia.

<b>Crop</b>	<b>Species Name</b>	<b>n</b>	<b>W</b>	<b>L</b>	<b>Diam.</b>	<b>wt.</b>
Curuba	<i>Passiflora mollissima</i>	5	4.7 $\pm$ 0.11	11.1 $\pm$ 0.39	-	128.5 $\pm$ 8.36
Red Guava	<i>Psidium guajava</i>	1	6.6 $\pm$ 0	9.1 $\pm$ 0	-	189 $\pm$ 0
White Guava	<i>Psidium guajava</i>	1	7.3 $\pm$ 0	6.2 $\pm$ 0	-	191.2 $\pm$ 0
Granadilla	<i>Passiflora ligularis</i>	3	7.6 $\pm$ 0.19	8.5 $\pm$ 0.16	-	143.2 $\pm$ 11.47
Papayuela	<i>Carica</i>	1	6.8 $\pm$ 0	11.9 $\pm$ 0	-	200.3 $\pm$ 0
Anon	<i>Annona squamosa</i>	1	7.9 $\pm$ 0	8.4 $\pm$ 0	-	266.5 $\pm$ 0
Chirimoya	<i>Annona cherimola</i>	1	8.3 $\pm$ 0	8.1 $\pm$ 0	-	274.9 $\pm$ 0
Badea	<i>Passiflora quadrangularis</i>	1	10.4 $\pm$ 0	17.9 $\pm$ 0	-	953.6 $\pm$ 0
Chulupa	<i>Passiflora maliformis</i>	5	5.9 $\pm$ 0.29	6.4 $\pm$ 0.26	-	81.4 $\pm$ 11.64
Gulupa	<i>Passiflora pinnaefistipula</i>	7	4.6 $\pm$ 0.12	4.9 $\pm$ 0.15	-	37 $\pm$ 3.27
Lulo	<i>Solanum quitoense</i>	5	6.4 $\pm$ 0.19	6.3 $\pm$ 0.13	-	140.4 $\pm$ 10.18
Golden Berries	<i>Physalis peruviana</i>	30	1.9 $\pm$ 0.03	1.9 $\pm$ 0.03	-	4.4 $\pm$ 0.19
Avocado	<i>Persea americana</i>	2	7.1 $\pm$ 0.1	13.9 $\pm$ 0.8	-	353.8 $\pm$ 7.4
Calabaza Verde/Green						
Squash	<i>Curcubita pepo</i>	1	12.4 $\pm$ 0	21.7 $\pm$ 0	-	1806.1 $\pm$ 0
Zarzamora/Moron	<i>Rubus macrocarpus</i>	30	2 $\pm$ 0.03	3 $\pm$ 0.04	-	7.9 $\pm$ 0.18
Mora de Castilla	<i>Rubus glaucus</i>	30	1.8 $\pm$ 0.02	2.2 $\pm$ 0.05	-	4.8 $\pm$ 0.22
Mora Silvsilveste	<i>Rubus adenotrichus</i>	30	0.7 $\pm$ 0.01	0.8 $\pm$ 0.02	-	0.3 $\pm$ 0.09
Agras	<i>Vaccinium meridionale</i>	30	0 $\pm$ 0	0 $\pm$ 0	0.8 $\pm$ 0.03	0.4 $\pm$ 0.13
Guanabana	<i>Annona muricata</i>	1	12.1 $\pm$ 0	20.5 $\pm$ 0	-	1351.8 $\pm$ 0

n= sample size. W= width. L= length. H= height. Wt= weight.

Table 10: Mean *aji* size measurements ( $\pm$  standard error) purchased in Cundinamarca, Colombia.

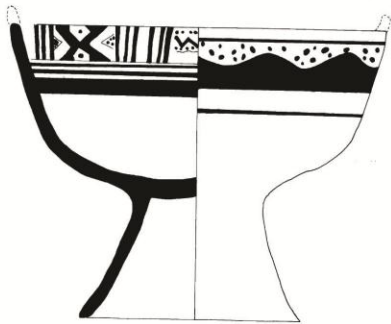
Crop	Species name	n	W	L	wt.
Chichiporro/rojo nacional	<i>Capsicum pubescens</i>	2	$1.8 \pm 0.23$	$8.1 \pm 0.32$	$8.7 \pm 2.35$
Pajarita	<i>Capsicum sp.wild</i>	30	$0.6 \pm 0.02$	$0.6 \pm 0.02$	0.16

Table 11: Mean *tomate árbol* *Cyphomandra batacea* size measurements ( $\pm$  standard error) purchased in Cundinamarca, Colombia.

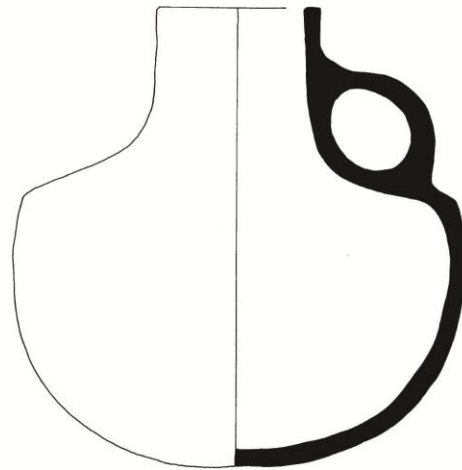
Varieties	n	W	L	wt.
Común	4	$5.9 \pm 0.1$	$7.1 \pm 0.12$	$123.6 \pm 4.24$
Rojo	3	$5.8 \pm 0.07$	$6.6 \pm 0.16$	$115.8 \pm 4.23$
Amarillo	5	$5.6 \pm 0.13$	$6.9 \pm 0.05$	$108.2 \pm 2.96$

n= sample size. W= width. L= length. H= height. Wt= weight.

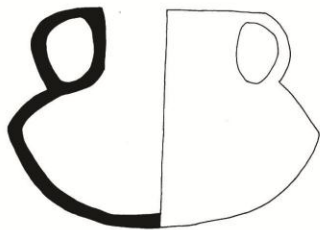
## **APPENDIX D: ARTIFACT SCALE DRAWINGS**



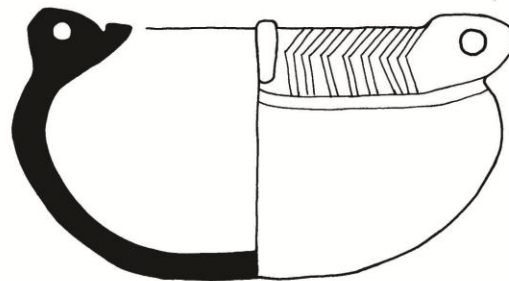
Late Muisca pedestal cup



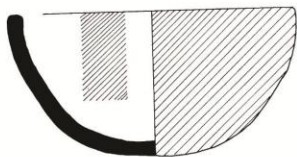
Muisca jar



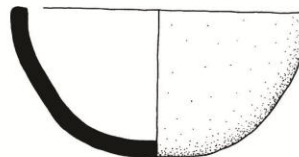
Muisca small olla



Muisca small painted and incised olla

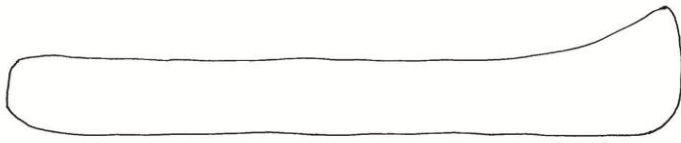


Muisca cuenco

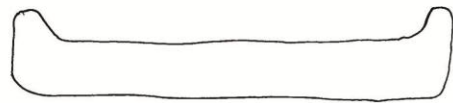
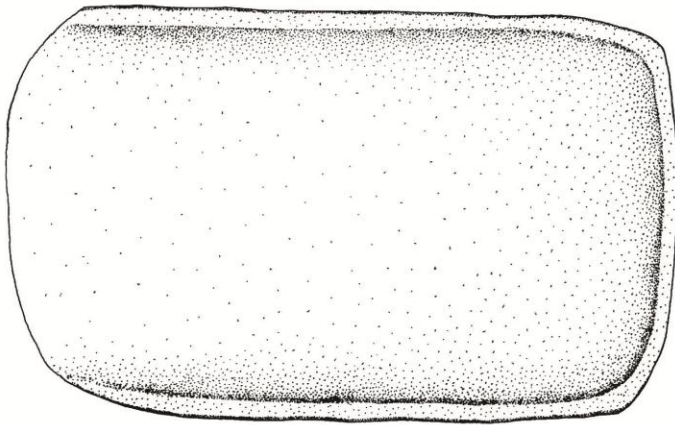
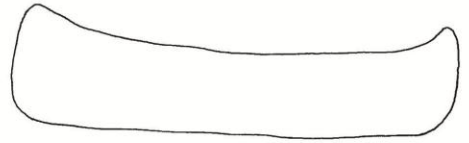


Muisca cuenco

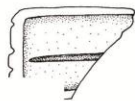




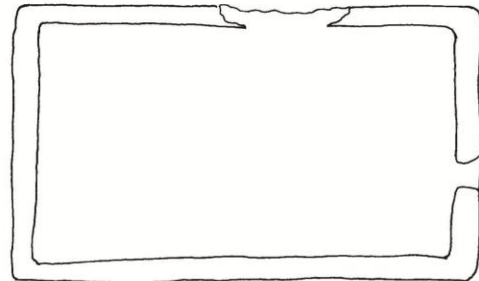
Muisca metate

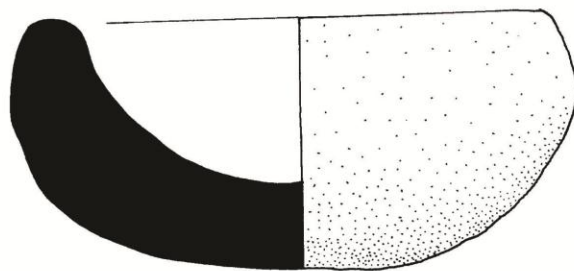
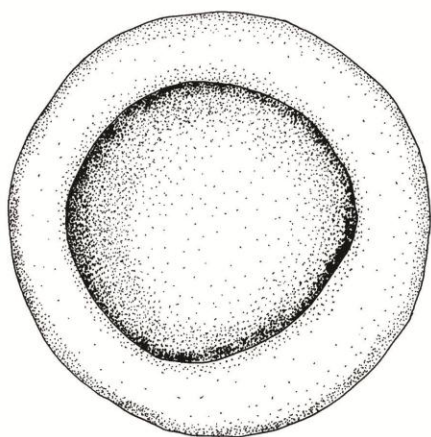


Muisca metate

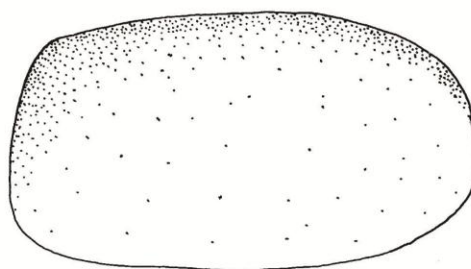
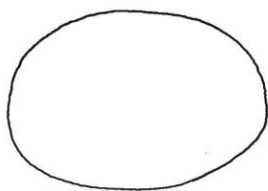
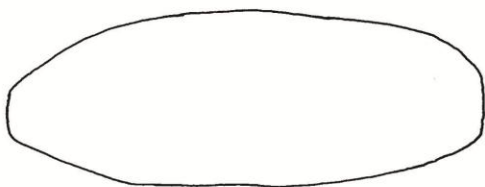


Muisca narcotics container



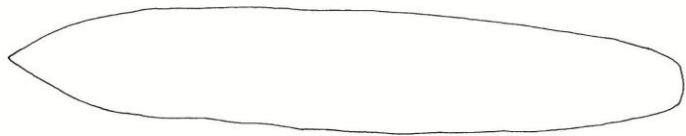
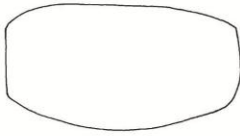
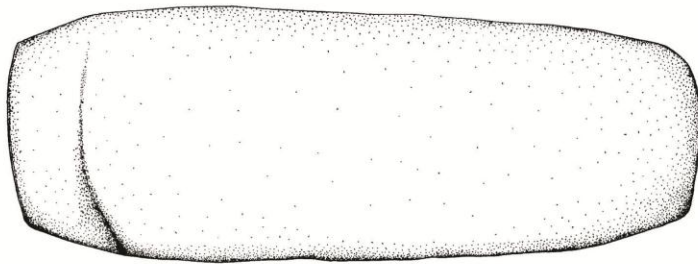


Muisca granite mortar

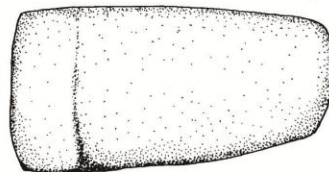
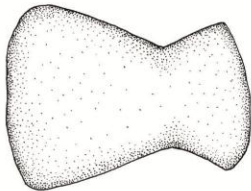
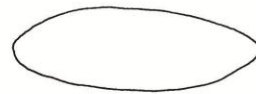


Muisca mano



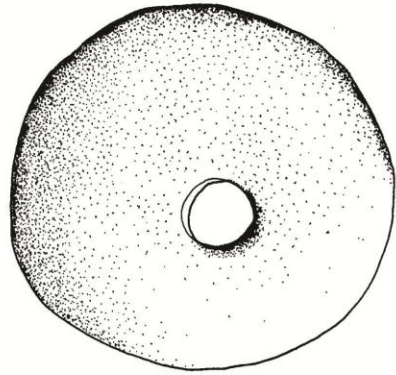
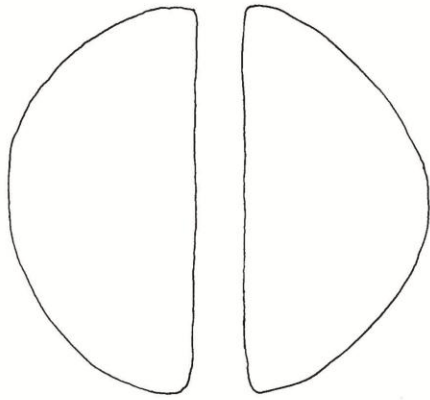


Muisca axes

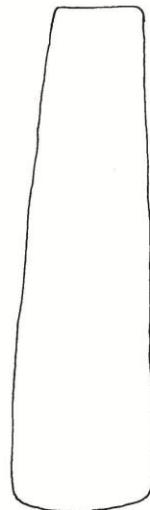
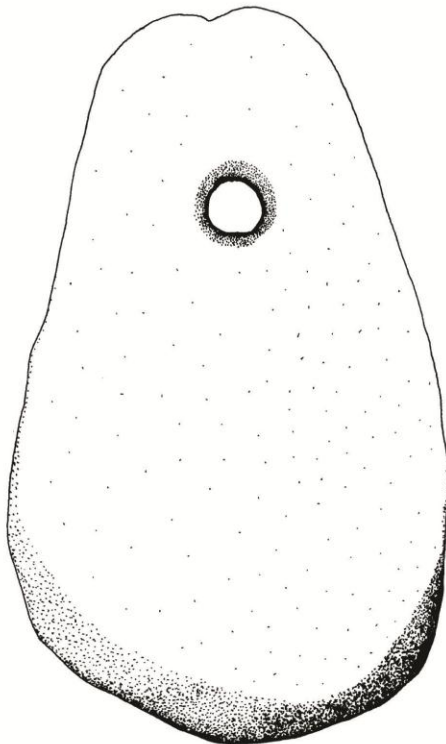


0 1 2 cm

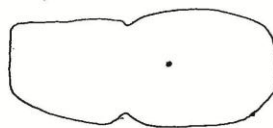
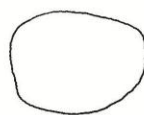
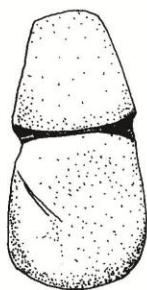
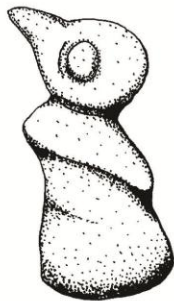




Fishing net weights

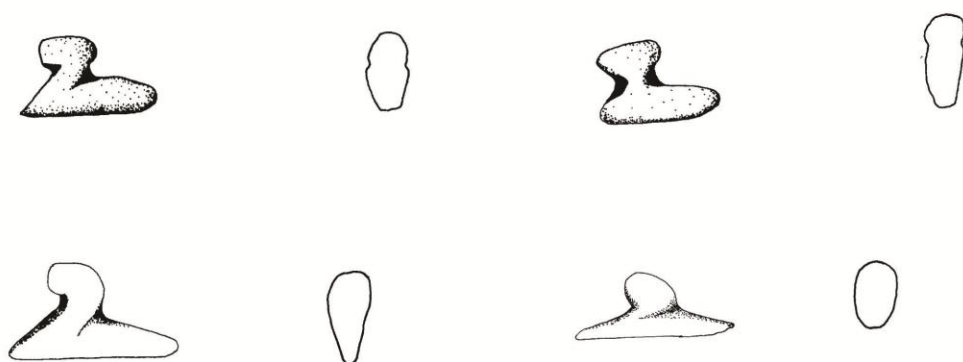


Muisca stylized pestles

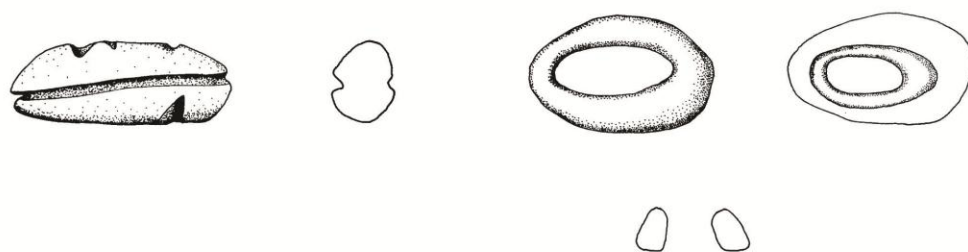


0 1 2 cm

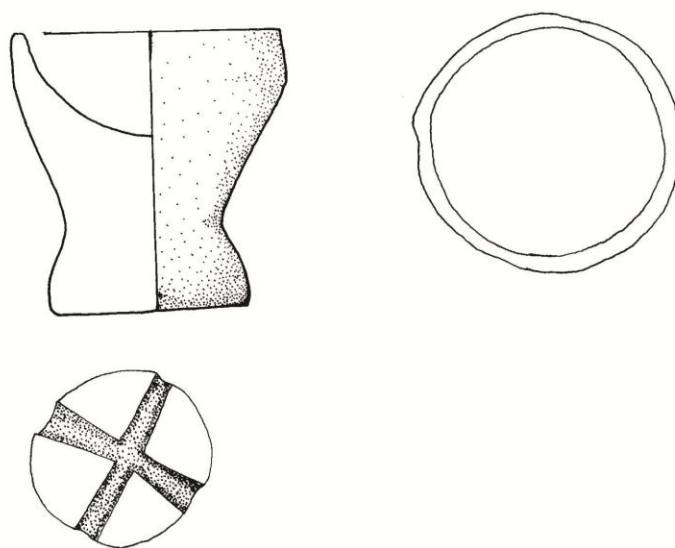
Muisca atlatls



Muisca sharpeners



Muisca carved mortar



0 1 2 cm

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